PB83-910207

U.S. DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

SELECTED WATER RESOURCES ABSTRACTS

VOLUME 16, NUMBER 7
JULY 1983

W83-02101 -- W83-02450
CODEN: SWRABW

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Directory of the Office of Management and Budget through September 30, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey, MS 421
Reston, VA 22092

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

PREDICTING PEAK STREAM FLOW FROM AN UNDISTURBED WATERSHED IN THE CENTRAL APPALACHIANS,
M. S. Brewer, R. Lee, and J. D. Helvey.
Water Resources Bulletin, Vol 18, No 5, p 755-759, October, 1982. 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Rainfall intensity, *Hydrologic models, *Flood peak, Rainfall-runoff relationships, Model studies, Streamflow, Rainfall duration, Precipitation intensity, Runoff, Hydrographs, West Vrginia, Appalachian region, Forest watersheds.

Rainfall and streamflow data from a small forested catchment in West Virginia were used to model peak streamflow as a function of hydrologic variables. Data from 112 storms were chosen from snow-free periods during the 1952-78 record. Only storms with single peaked hydrographs and continuous rainfall were used. All parameters were extremely variable. Antecedent rainfall and storage were excluded as significant variables, and 1, 2, and 3-variable models were tested. The 2-variable models (rainfall depth and initial flow rate) and 3-variable models (rainfall depth, initial flow rate, and rainfall duration) underestimated the larger peak flows. An attempt to improve the basic models using expressions of rainfall intensity (temporal sequence of intensity and maximum intensity) was not effective. The most intense rainfall generally occurred in the earliest part of the storm. Mean rainfall intensity for an entire storm was generally as useful as shorter interval intensities. (Cassar-FRC)
W83-02150

ASSESSING THE EFFECT OF SPATIAL PATTERN OF PRECIPITATION IN MODELING STREAM FLOW HYDROGRAPHS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
K. J. Beven, and G. M. Hornberger.
Water Resources Bulletin, Vol 18, No 5, p 823-829, October 1982. 4 Fig, 4 Tab, 14 Ref.

Descriptors: *Hydrologic models, *Spatial distribution, *Rainfall distribution, *Rainfall-runoff relationships, Model studies, Precipitation, Streamflow, Hydrogrpahs, Storms, Rainstorms, Catchments, Friends Creek, Goose Creek, *Illinois.

Data collected in July and August 1979 from two intensive rainfall recording experiments in Goose and Friends Creeks basins, Illinois, were use to study the effects of rainfall spatial distribution on stream hydrographs for summer convective storms. Threshold analysis showed that the available sample size was not sufficient to discern the effects of spatial variability. Therefore, a deterministic/stochastic modeling approach was then used to generate storms of different patterns (1000 summer storms representing 75-100 years) to find the aspects of catchment response most likely to be affected by spatial variability. Differences in peak timing resulting from the different patterns were highly significant, differences in distributions of peak flow were significant, and differences in distributions of storm flow volumes were insignificant. In a highly variable spatial pattern the most important factor in predicting stream hydrographs was the correct volume of input. Rainfall pattern itself had only a secondary effect on hydrograph characteristics. (Cassar-FRC)
W83-02152

DETERMINING RAINS OF HYDROLOGIC CONSEQUENCE IN CHICAGO FOR FORECASTING APPLICATIONS,
Illinois State Water Survey Div., Champaign.
S. A. Changnon, Jr.
Water Resources Bulletin, Vol 18, No 5, p 857-861, October, 1982. 5 Tab, 14 Ref.

Descriptors: *Urban runoff, *Storm water, *Overflow, *Chicago, *Illinois, Precipitation, Runoff, Water management, Storm-overflow sewers, Hydrometeorology, Meteorology, Rainfall distribution, Storms, Storm sewers, Flooding, *Weather forecasting.

Analysis of rainstorm data in the Chicago, Illinois, area indicated that undesirable storm runoff into Lake Michigan was produced by rains exceeding 2 inches in a few hours. Since 1947 there have been 139 storms of = or > 2 inches and 34 overflows. Three of the overflows occurred with storms < 2 inches. Although the number of 2 inch storms per 5-year period has varied randomly from 14 to 26, the number of overflows per 5-year period increased from 3 for each 5-year period for 1948-1971 to 6 in 1972-76 and 13 in 1977-81. Failure to forecast runoff or to operate the storm water system properly occurred most often in spring and fall in the past and in June and July more recently. Analysis of the distribution of storms in north (produces greatest problems), central, and south sections of the basin showed no statiscally significant differences over the 35-year period. Changes in land use have been minimal during the past 10 years. The Chicago Hydrometeorological Area Program is capable of predicting short duration > 2 inch rainstorms 2 hours in advance with 80% accuracy. Since other causes of overflows have not been identified, it is possible that use of this predictive method can aid in better storm runoff management by lowering the volume in the system in advance of a storm. (Cassar-FRC)
W83-02167

APPLICATION OF QUANTITATIVE GEOMORPHIC ANALYSIS TO THE GEOGRAPHIC BASINS OF PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Geography.
N. Liberatore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177980, Price codes: A06 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Mayaguez, 1983. 102 p, 28 Fig, 49 Tab, 9 Ref. OWRT A-060-PR(1), 14-34-0001-1141.

Descriptors: Geomorphology, *Drainage systems, *Drainage basins, Hydrogeology, Drainage density, River systems, Puerto Rico, Tallaboa River basin, *Network design.

This investigation was performed with the purpose of implementing in Puerto Rico the investigation of geomorphic factors that characterize drainage systems and to elucidate and interpret the relationship between geologic-structural conditions and the hydrologic characteristics. The area selected as the sample was the Tallaboa river basin, because of its peculiarity of the distribution of its surface rocks and because of the availability of hydrologic information for the area. In order to accomplish the investigation the hydrographic network obtained from aerial photographs was designed and systematically transferred to the topographic base represented by the U. S. Geological Survey (U.S.G.S) maps at a scale of 1:20,000. The hydrography was successively classified based in the order of confluence of the different river reaches. The morphometric parameters, represented by the frequency, length, slope and perimeter of each basin, were calculated for the subbasins in which the area was subdivided as well as for the entire basin. Other parameters calculated were: branching rate; number, density, and index of hierarchical anomalies; the permanence constant of the reaches; circularity and elongation ratio; the relief ratio; the drainage density; and the length of the drainage and its form. (Munoz, Puerto Rico)
W83-02213

IMPROVING WATERSHED-MODEL ACCURACY BY USING DIGITAL TOPOGRAPHY,
West Virginia Univ., Morgantown. Water Research Inst.
R. N. Eli, and M. J. Paulin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178137, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, 1983. 57 p, 28 Fig, 6 Tab, 14 Ref. OWRT A-046-WVA(1), 14-34-0001-1152.

Descriptors: *Computer models, *Hydrograph analysis, Model studies, *Simulation analysis, *Terrain analysis, *Topography, *Watersheds, Basins, Digital computers, Hydrographs, Mathematical models, Statistical models, Synthetic hydrology, Unit hydrographs.

An 11 square-mile watershed was modeled using three different resolution-triangulated digital-terrain models. The number of triangular elements varied from 176 to 784. The objective was to test the sensitivity of a distributed unit-hydrograph model to changing element size. Each triangular element and stream segment was modeled as a sequential linear-reservoir/linear-channel element. It was determined that the overland-flow elements (the triangular elements) were relatively insensitive to lag-time proportioning, while the stream segments were relatively sensitive. The lack of sensitivity in overland flow is explained by the relatively steep watershed topography and the resulting short lag time of overland flow as compared to stream lag. A 50 to 75% weighting toward linear-channel lag contribution yielded similar output results for each resolution level, and seemed logically consistent with the physical characteristics of the watershed. It was concluded that use of a distributed linear-reservoir/linear-channel model, in conjunction with a triangulated digital terrain model, does not require a high resolution representation (i.e., many triangles) to yield acceptable results.
W83-02233

PARAMETER ESTIMATION OF MULTIPLE INPUT-OUTPUT TIME SERIES MODELS: APPLICATION TO RAINFALL-RUNOFF PROCESSES,
Princeton Univ., NJ. Dept. of Civil Engineering.
D. M. Cooper, and E. F. Wood.
Water Resources Research, Vol 18, No 5, p 1352-1364, October, 1982. 6 Fig, 3 Tab, 22 Ref.

Descriptors: *Hydrologic models, *Time series analysis, *Streamflow forecasting, *Model studies, Rainfall-runoff relationships, Parametric hydrology, Runoff, River flow, Tributaries.

In time series modeling of hydrologic systems the model structure either is determined a priori from physical considerations or is identified statistically. This paper sets forth a maximum likelihood procedure for estimating the parameters of a class of statistical models (linear time-invariant state-space) once a suitable member of the class has been identified. Using the innovation form of the state-space model, the parameters of the transition, input weighting, gain and output, or measurement matrices are estimated as well as the innovation covariance matrix. Procedures for estimating process and measurement covariances in the state-space model, and the parameters of the equivalent multivariate autoregressive moving average with exogenous inputs (ARMAX) model are also developed. A convergent and asymptotically efficient on-line method of estimation is derived from the off-line algorithm. Four examples are presented: daily rainfall-runoff forecasting, four-site monthly streamflow, seasonal model, and river flow input-output model with a tributary. (Author abstract)
W83-02278

CHOOSING AMONG HYDROLOGIC REGRESSION MODELS 2. EXTENSIONS TO THE STANDARD MODEL,
Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
J. B. Valdes, G. J. Vicens, and I. Rodriguez-Iturbe.
Water Resources Research, Vol 16, No 3, p 507-516, June, 1980. 4 Fig, 3 Tab, 11 Ref.

Descriptors: *Hydrologic models, *Regression analysis, *Model studies, Floods, Annual floods, Flow, Streamflow, Rainfall-runoff models.

An extension of the use of posterior probabilities as a criterion for discriminating among alternative hydrologic regression models is presented. The Bayesian discrimination procedure was used in several experiments in which the covariance matrix of

the disturbances did not have scalar form. Experiments included both synthetic and real data in regression that relate the mean annual flows and floods with the meteoroligical and physiographic basin characteristics. The procedure proposed in this paper places the highest posterior probabilities on the correct models, showing that Bayesian discrimination is useful in choosing alternative models and as a complement to traditional measures of performance. (Cassar-FRC)
W83-02279

SOIL-VEGETATION-HYDROLOGY STUDIES, VOLUME II, A USER MANUAL FOR ERHYM: THE EKLAKA RANGELAND HYDROLOGY AND YIELD AND MODEL,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
J. R. Wight, and E. L. Neff.
Agricultural Research Results ARR-W-29, January 1983. 42 p, 5 Fig, 17 Ref, 1 Append.

Descriptors: *Hydrologic models, *Rangelands, *Soil water, *Runoff, *Soil-water-plant relationships, *Vegetation, Model studies, Climate, Snowmelt, Evapotranspiration, Range management, Simulation, Infiltration.

The Ekalaka Rangeland Hydrology and Yield Model (ERHYM) was developed to simulate runoff and herbage production for northern Great Plains rangelands. It is a range site scale model that provides daily simulation of runoff, soil water evaporation, transpiration, and soil water routing. Herbage yield is computed annually at peak standing crop. The model can use real-time climatic data to simulate ongoing processes, or it can utilize historical climatic data to simulate runoff and herbage production under a range of climatic conditions and management practices. It can run either on a seasonal basis, with new soil water boundary conditions required at the beginning of each year's growing season, or continuously, utilizing a simple snowmelt-temperature relationship to account for snowmelt infiltration and runoff. This users manual contains the model description, model documentation, input and output parameters, and an example of model use in which model output is compared with field measured data. (Moore-SRC)
W83-02314

THE TURNING BANDS METHOD FOR SIMULATION OF RANDOM FIELDS USING LINE GENERATION BY A SPECTRAL METHOD,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
A. Mantoglou, and J. L. Wilson.
Water Resources Research, Vol 18, No 5, p 1379-1394, October, 1982. 12 Fig, 2 Tab, 30 Ref.

Descriptors: *Stochastic hydrology, *Hydrologic models, *Turning bands method, *Monte Carlo method, Model studies, Simulation analysis, Groundwater movement, Mass transfer, Rainfall-runoff relationships.

The turning bands method (TBM) for simulation of multidimensional random fields is described. Random fields often occur in the Monte Carlo simulation of hydrologic processes such as groundwater flow, mass transport, and rainfall-runoff models. The basic concept of the TBM is to transform a multidimensional simulation into the sum of a series of equivalent unidimensional simulations. This paper concentrates on the two-dimensional stationary process, which is more complicated than the one- or three-dimensional processes. For stationary two- dimensional fields the unidimensional line process is generated by simple spectral methods. The TBM is shown to be ergodic even for a finite number of lines. It rapidly converges to the true statistics of the field. Guidelines are given to help select model parameters helpful in the design of simulation experiments. TBM is as accurate as but much less expensive than the multidimensional spectral techniques and more accurate than the expensive appproaches using matrix inversion. (Cassar-FRC)
W83-02337

COMPARISON OF ESTIMATORS OF STANDARD DEVIATION FOR HYDROLOGIC TIME SERIES,
Geological Survey, Reston, VA.
G. D. Tasker, and E. J. Gilroy.
Water Resources Research, Vol 18, No 5, p 1503-1508, October, 1982. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Hydrologic models, *Estimating, *Time series analysis, Model studies, *Monte Carlo Method, Mathematical studies.

A set of Monte Carlo experiments was carried out to compare five estimators of standard deviation of a serially correlated hydrologic time series. Three methods provided estimates of the standard deviation which were much less biased but had greater mean square errors than the usual estimate. The three methods may be briefly characterized as a method using a maximum likelihood estimate of the unbiasing factor, a method using an empirical Bayes estimate of the unbiasing factor, and a robust nonparametric estimate of the standard deviation. (Baker-FRC)
W83-02346

ESTIMATION OF PEARSON TYPE 3 MOMENTS,
Utah Univ., Salt Lake City. Dept. of Civil Engineering.
U. Lall, and L. R. Beard.
Water Resources Research, Vol 18, No 5, p 1563-1569, October, 1982. 5 Fig, 7 Tab, 13 Ref.

Descriptors: *Floods, *Frequency distribution, *Statistical models, Mathematical studies, Model studies, Hydrologic equation.

Estimates of frequencies of floods and other events are based on statistical distributions estimated from sample data. The most common and generally the most robust technique used is the fitting of data by the method of moments. The study described examines the fact that all of such work has been based on considering the variation of statistics of various samples drawn from a specified population, whereas the real interest is in the range of likely parent population parameters corresponding to a statistic obtained from a unique sample with regard to a particular functional form of parent distribution and for the case where the a priori distributions of the parameters are uniform, that is, where all values of a particular parameter are equally likely on an arithmetic scale. The distribution function studied is the Pearson type 3, and the parameter of primary attention is the skew coefficient. (Baker-FRC)
W83-02353

2B. Precipitation

DISTRIBUTION AND STOCHASTIC GENERATION OF ANNUAL AND MONTHLY PRECIPITATION ON A MOUNTAINOUS WATERSHED IN SOUTHWEST IDAHO,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
C. L. Hanson.
Water Resources Bulletin, Vol 18, No 5, p 875-883, October, 1982. 6 Fig, 7 Tab, 20 Ref.

Descriptors: *Watersheds, *Seasonal variation, *Distribution patterns, Precipitation gages, Reynolds, Creek, *Idaho, Mountains, Snow, Hydrology, Elevation, Simulation analysis, Gaging stations, Stochastic hydrology, *Spatial distribution, Areal precipitation, Local precipitation, Cyclonic precipitation, Precipitation.

The spatial distribution of annual and monthly precipitation was determined using 18 years of data collected from the dense gage network (38 sites) on the Reynolds Creek Experimental Watershed, Idaho. Most of the winter storms, cyclonic in nature, move over the watershed from the west to southwest. Heaviest precipitation is on the west (downwind) side of the watershed. Grouping the gaging sites into upwind and downwind produced two separate lines on the annual precipitation vs. elevation graph. Downwind stations had about 300 mm of average annual precipitation vs. elevation graph. Downwind stations had about 300 mm of average annual precipitation at 1200 m elevation and 1100 mm at 2200 m; upwind stations, 250 mm at 1300 m and 800 mm at 2200 m. Maximum annual precipitation was found just leeward of the western watershed boundary. Results of simulation of 50 years of annual precipitation data using the log-normal two-parameter distribution for 4 gage sites were within 2-16% of measured values. The monthly precipitation-elevation relationship was also best represented by separating the sites into upwind and downwind groups. During summer, when local thrunderstorms were the main source of precipitation and some months were altogether dry, results for upwind and downwind stations were combined. During the summer months there was a small precipitation increase with increase in elevation compared with winter. Monthly precipitation at all locations was simulated satisfactorily by the cube root-normal distribution. Simulated results for 50 years at four sites were close to measured results, the greatest difference being 7%. (Cassar-FRC)
W83-02154

VARIABILITY OF PRECIPITATION IN THE PACIFIC NORTHWEST: SPATIAL AND TEMPORAL CHARACTERISTICS,
Portland State Univ., OR. Dept. of Geography.
D. M. Johnson, and J. O. Dart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175232, Price codes: A15 in paper copy, A01 in microfiche.
Water Resources Research Institute Publication WRRI-77 (2 Vol), Oregon State University, Corvallis, May 1982. 327 p, 23 Fig, 7 Tab, 124 Ref, 5 Append. OWRT A-050-ORE(2).

Descriptors: *Precipitation, *Precipitation variability, *Pacific Northwest, Oregon, Washington, *Precipitation statistics, Precipitation trends, *Precipitation patterns, Data collections, *Temporal distribution, *Spatial distribution, Climatology, Climatic data, *Seasonal variation, *Annual distribution.

Spatial and temporal aspects of precipitation in the Pacific Northwest were analyzed for natural variability. The data base consists of monthly, seasonal and annual totals of precipitation for 244 climatological stations in Oregon, Washington and adjacent areas. A complete set of descriptive and inferential statistics was calculated and is presented in tabular form. Maps of key statistics---means, coefficients of variation and interstation correlation coefficients--depict spatial patterns. The 40-year normal period is shown to be sufficient for making probability estimates of seasonal and annual precipitation. Temporal variability in seasonal and annual precipitation over the last 100 years is studied with 70 long-term stations in Oregon and Washington. Trends, linear and non-linear, are determined and show that the spatial variation in temporal changes is great. There is little evidence to suggest either a progressive increase or decrease in annual precipitation in Oregon over the last century. In Washington there has been a tendency for decreasing amounts of annual precipitation. Changes over shorter time periods are also analyzed. The one persistent temporal pattern throughout the region is a downward trend extending from the 1890's to about 1930 and a gradual recovery in recent decades. However, there are many local variations of this pattern. The decade of the 1970's is marked by extremely high interannual variability, a finding consistent with studies from all parts of the globe.
W83-02178

EFFECT OF THE ENERGY OF RAIN ON ITS INFILTRATION INTO SOIL,
Mowcow Inst. of Land-Management Engineers (USSR).
For primary bibliographic entry see Field 2G.
W83-02249

PRECIPITATION CHARACTERISTICS AFFECTING HYDROLOGIC RESPONSE OF SOUTHWESTERN RANGELAND,

Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
H. B. Osborn.
Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-34, January 1983. 59 p, 44 Fig, 8 Tab, 57 Ref.

Descriptors: *Rangeland, *Precipitation, Model studies, *Rainfall intensity, Distribution, Areal precipitation, Thunderstorms, *Convective precipitation, Variability, *Depth-area-duration analysis, New Mexico, Arizona.

This publication provides an up-to-date and definitive source of precipitation data for ranchers and others involved in range management and range renovation programs. The period of record (25 years) is such that specific probabilities now can be assigned to rainfall occurrences on an areal basis to provide a good estimate of the change of success or failure of any range management or renovation program as well as expected amounts of rainfall in a given basin for downstream water users. Early efforts were primarily to identify the unusual features of summer convective rainfall and show the variability in time and space. A complimentary effort was to develop seasonal and annual means and ranges of precipitation along with the spatial variability in such values. Point-to-area and depth-area-frequency relationships have been developed which can be used in similar climatic regions. Efforts to develop precipitation models have included revision or improvement in methods or models that were not originally designed for use in areas where the climate is dominated by thunderstorm rainfall, as it is in the Southwest. (Moore-SRC)
W83-02316

STOCHASTIC DAILY PRECIPITATION MODELS, 2. A COMPARISON OF DISTRIBUTIONS OF AMOUNTS,
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
D. A. Woolhiser, and J. Roldan.
Water Resources Research, Vol 18, No 5, p 1461-1468, October, 1982. 7 Tab, 17 Ref.

Descriptors: *Stochastic hydrology, *Precipitation, *Model studies, Rainfall, Stochastic process, Mathematical studies, Rainfall intensity, Rainfall rate, Rainfall distribution.

Chain-dependent and independent exponential, gamma, and mixed exponential distributions are compared as models for the distribution of daily precipitation. Parameters for each distribution are estimated by maximum likelihood techniques for 14 day periods. The Akaike information criterion is used to select the most appropriate distribution for each period and for the entire year. For the five U. S. stations studied, the independent mixed exponential distribution was the best on the basis of the Akaike information criterion, and the independent gamma and chain-dependent gamma ranked second and third, respectively. Fourier series are fit to the parameters by least squares to provide starting values for subsequent numerical maximum likelihood estimates of the Fourier coefficients. According to the Akaike information criterion, the Fourier series description of model parameters for the mixed exponential model is superior to the specification of parameters for each 14 day period. (Baker-FRC)
W83-02341

STOCHASTIC DAILY PRECIPITATION MODELS. I. A COMPARISON OF OCCURENCE PROCESSES,
Cordoba Univ. (Spain). Catedra de Hidraulica General y Agricola.
J. Roldan, and D. A. Woolhiser.
Water Resources Research, Vol 18, No 5, p 1451-1459, October 1982. 2 Fig, 3 Tab, 14 Ref.

Descriptors: *Stochastic hydrology, *Model studies, *Precipitation, Rainfall, *Stochastic process, Mathematical studies, *Markov chain.

A first-order Markov chain and an alternating renewal process (ARP) with a truncated geometric distributions of wet day intervals and truncated negative bionomial distribution of dry day intervals are compared as models describing the occurence of sequences of wet and dry days. Numerical optimization techniques are used to obtain approximate maximum likelihood estimates of the Fourier coefficients which describe the seasonal variation of the two Markov chain parameters and the three parameters in the alternating renewal process. The likelihood functions for the ARP were not significantly greater than those for the Markov chain, and the Markov chain resulted in the minimum Akaike information criteria for the four rainfall stations that were compared. Because the numerical optimization technique to estimate Fourier coefficients by the method of maximum likelihood required considerably more computer time for the alternating renewal process than for the Markov chain, economic as well as statistical considerations suggest that the Markov chain model is superior for the stations considered for the record lengths of 20 to 25 years. The likelihood ratio test at the 0.01 level and the Akaike information criterion gave similiar results when used to determine the number of significant harmonics. (Baker-FRC)
W83-02342

MODIFIED SMEMAX TRANSFORMATION FOR FREQUENCY ANALYSIS,
Mosul Univ. (Iraq). Dept. of Irrigation and Drainage.
H. R. Rasheed, M. V. Ramamoorthy, and A. S. Al-Dabbagh.
Water Resources Bulletin, Vol 18, No 3, p 509-512, June, 1982. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Frequency analysis, *Precipitation, *Mathematical models, Rainfall, Probability distribution, Stationary process, Mathematical studies, Stochastic process, Statistical study, Model studies.

Estimates of floods and rainfall of specified frequency are often made through the use of a particular probability distribution function fitted to historical data. Instead of fitting a known distribution function to a set of hydrologic data, it is sometimes worthwhile to reconstitute the data by a suitable transformation so that the transformed data follows a particular distribution. Bethalmy (1977) suggested the SMEMAX transformation as a normalizing transformation to allow the normal distribution function to be used, thus simplifying the subsequent analysis. In the present work, an alternative and simpler form of the SMEMAX transformation is put forward which avoids the use of trigonometric functions. Transformed variables range from 0 to 100, and are near normally distributed. The simplicity of the modified SMEMAX transformation is demonstrated in its application to data of total annual precipitation at Baghdad. This modified form of the SMEMAX transformation should prove useful for practicing engineers involved in the design of hydraulic structures. (Geiger-FRC)
W83-02436

2C. Snow, Ice, and Frost

EFFECT OF VIEWING ANGLE ON THE INFRARED BRIGHTNESS TEMPERATURE OF SNOW,
California Univ., Santa Barbara. Dept. of Geography.
J. Dozier, and S. G. Warren.
Water Resources Research, Vol 18, No 5, p 1424-1434, October, 1982. 10 Fig, 2 Tab, 32 Ref.

Descriptors: *Remote sensing, *Infrared imagery, *Snow surveys, Satellite technology, Brightness temperature, Albedo, Emissivity, Temperature.

Remote sensing of snowpack temperatures from satellites requires knowledge of the spectral emissivity of snow. A model for spectral emissivity is combined with the Planck function to calculate brightness temperature of snow in thermal infrared wavelengths for a range of grain sizes and viewing angles. Emissivity variations caused by density, grain shape, liquid water, and grain size are apparently unimportant, but emissivity varies with viewing angle to produce differences between thermodynamic temperature and brightness temperature as large as 3 K at wavelengths 23 to 14 microns, within the major atmospheric infrared window. This difference is also verified by experimental measurements. An equation to convert brightness temepratures to thermodynamic temperatures is presented, and this is also combined with a dual-wavelength atmospheric correction method. The spectral emissivity model is also used to calculate an 'all-wave' emissivity of snow: 0.985-0.990 for all grain sizes. (Author's abstract)
W83-02355

MODELING OF THE MELTING OF SNOW IN MOUNTAINS AND ARRIVAL OF WATER ON THE DRAINAGE BASIN SURFACE WITH THE USE OF SATELLITE INFORMATION,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
E. L. Muzylev, and L. K. Poplavskaya.
Water Resources, Vol 9, No 1, p 31-37, January/February, 1982. 2 Fig, 16 Ref. Translated from Vodnye Resursy, No 1, p 66-73, January/February, 1982.

Descriptors: *Snowmelt, *Satellite technology, *Streamflow forecasting, Melting, Snow cover, Snow accumulation, Runoff, Model studies, Watersheds, Gavasai River, *USSR, River basins, Mountains, Snowline, Hydrologic models, Remote sensing.

Satellite observations (1975-79) of the accumulation and melting of snow in mountains were used to model the formation of snow cover and runoff hydrographs for the Gavasai River basin in the Chaikal Range, USSR, drainage area 657 sq km. Snow cover was estimated from the photographs for five altitudinal zones: below 1200 m, above 3000 m, and three intermediate zones. Accuracies in determing snow cover were 6-10%; for snow line location, 150-300 m with respect to height. A model was developed to predict runoff at the basin outlet. Observed hydrographs did not match predicted values for all years. Actual discharges increased markedly at the end of March and beginning of April, whereas the model predicted the increase to occur in March. These differences were caused by neglect of infiltration and evaporation losses, the degree of saturation of the basin at the beginning of rainfall, and other consideration. However, it was possible to model the course of melting and formation of snow cover. (Cassar-FRC)
W83-02419

2D. Evaporation and Transpiration

COMMENT ON 'ESTIMATING EVAPOTRANSPIRATION FROM THE SONOITA CREEK WATERSHED NEAR PATOGONIA, ARIZONA' BY J. BEN-ASHER: AND REPLY BY AUTHOR,
National Hydrology Research Inst., Ottawa (Ontario).
F. I. Morton.
Water Resources Research, Vol 18, No 4, p 1287-1291, August, 1982. 1 Fig, 27 Ref.

Descriptors: *Watersheds, *Evapotranspiration, *Estimating, Mathematical equations, Mathematical models, Model studies, Seasonal variations, Radiation, Net radiation, Hydrologic budget, *Arizona, Sonoita Creek watershed.

In this comment on the cited research (Water Resources Research, Vol 17, p 901-906, 1981) the author suggests several areas of concern in the equations used for estimating evapotranspiration from this area of study. Note is taken of the fact that CRAE-1975 (complementary relationship areal evapotranspiration) models do not take into account the seasonal changes in net radiation that occur as the ground dries. The error analysis as presented grosaly overestimates the effects of the aforementioned changes in net radiation. The author of the original work responds by stating that the CRAE formula simplifies a complex soil-plant atmosphere continuum phenomenon and is therefore subject to criticism, particularly by meteorologists. However, it can be supported by hy-

drologists and soil physicists, as it can give estimates of areal evapotranspiration as accurately as any other available method. (Baker-FRC)
W83-02144

EVAPOTRANSPIRATION ESTIMATES BASED ON SURFACE TEMPERATURE AND NET RADIATION: DEVELOPMENT OF REMOTE SENSING METHODS,
Florida Univ., Gainesville. Dept. of Agronomy.
K. F. Heimberg, L. H. Allen, Jr., and W. C. Huber.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175307, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Center Publication No. 66, Univ., of Florida, Gainesville, 1982. 210 p, 40 Fig, 8 Tab, 62 Ref, 4 Append. OWRT A-040-FLA(1), 14-34-0001-0110, 14-34-0001-1110.

Descriptors: *Evapotranspiration, *Remote sensing, *Net radiation, *Surface temperature, Satellite, Micrometeorology, *Energy balance, Regional evapotranspiration, Evapotranspiration models, *Florida, Air temperature, Temperature gradients.

A generalized method for making evapotranspiration estimates using satellite data is presented. It is designed for good cumulative ET estimates based on surface temperature, air temperature, and net radiation data of limited time resolution. The surface is described by an equation relating surface-to-air temperature gradients, net radiation, moisture availability, bulk air thermal conductivity, saturation deficit, and a soil heat flux parameter. Given estimates of two of these factors, the other two can be determined from the correlation of temperature gradients and net radiation. The parameters are then used in a Penman-type equation to calculate ET using net radiation measurements made over a pasture surface. The ground truth ET measurements were made with the energy budget-profile Bowen ratio technique.
W83-02185

2E. Streamflow and Runoff

BASE FLOW OF STREAMS ON LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
R. J. Reynolds.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-257577, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-48, 1982. 33 p, 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Base flow, *Streams, *Surface-groundwater relations, Data collections, Stream gages, Flow duration, Stream discharge, Groundwater movement, Groundwater runoff, Drought, Sewer systems, Computer models, *Long Island, New York.

On Long Island, base flow under nonurbanized conditions constitutes 90 to 95% of total stream discharge. Base-flow data from 19 continuously gaged streams are presented as monthly mean and annual mean discharge for water years 1960-75, which includes the 1962-66 drought. The data were derived by hydrograph-separation procedures that isolate mean daily base flow from mean daily discharge. A close empirical relationship between annual mean base flow and stream discharge at the 55-% duration point facilities estimation of average base flow and can be used in place of the more time-consuming hydrograph-separation technique. These data are needed in calibration of computer models that will be used to predict the effects of hydrologic stresses, such as sewering, on the Long Island ground-water system. (USGS)
W83-02112

RECHARGE IN SEMIARID MOUNTAIN ENVIRONMENTS,
New Mexico Inst. of Mining and Technology, Socorro.
For primary bibliographic entry see Field 2F.
W83-02137

EVALUATION OF DROUGHT POTENTIALS AND DAMAGES IN THE NORTHEASTERN UNITED STATES,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
G. Aron, and G. B. Emmanuel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173328, Price codes: A08 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources Completion Report, Pennsylvania State Univ., University Park, September 1982. 158 p, 23 Fig, 17 Tab, 1 Exhibit, 33 Ref, 3 Append. OWRT B-124-PA(1), 14-34-0001-1261.

Descriptors: *Drought, *Drought damages, *Reservoirs, *Groundwater recharge, Water demand, Streamflow, Damages, Base flow, Water quality, *Pennsylvania, *Drought potentials, Northeast, Shortage, Precipitation shortfall, Minimum low flow requirements, Damage functions, Yields, Hydrologic events, *Flow augmentation, *Low-flow augmentation, Dissolved oxygen.

Drought is an infrequent hydrologic event in the northeastern United States in which the availability of water for a variety of uses becomes restricted. It is herein defined in terms of the various uses for streamflow and the sum of the minimum low flow requirements for each. Regression equations were developed for selected low rates using data from streamflow gaging stations in Pennsylvania. An examination was made of damages incurred by Pennsylvania water suppliers during the 1980-81 drought. Drought damage functions were formed. As a means to avoid drought damages, an analysis was made of size and costs of reservoirs required to provide desired yields with and without some acceptable shortage levels. Augmentation of streamflow by groundwater recharge is discussed. A scheme is presented for causing recharge of high flows and stormwater runoff in off-stream channels or canals such that base flow is augmented as the percolating water moves downslope to the stream. The effects of low streamflows on water quality were investigated. It was determined that the diurnal fluctuations of dissolved oxygen increased substantially when discharge rates dropped below normal dry-weather flows. These large fluctuations could affect fishlife and increase the corrosive effects of industrially used water.
W83-02141

CLUSTER MODEL FOR FLOOD PEAK ANALYSIS: APPLICATION TO LOWER OHIO RIVER BASIN,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
J. E. Cervantes, M. L. Kavvas, and J. W. Delleur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173344, Price codes: A09 in paper copy, A01 in microfiche. Technical Report 145, December 1982. 166 p, 30 Fig, 7 Tab, 32 Ref, 8 Append. OWRT B-112-IND(2).

Descriptors: Floods, *Statistical models, *Stochastic hydrology, *Stochastic processes, *Cluster models, *Ohio River Basin, Model studies, *Indiana, *Flood peak analysis, Rainfall clusters, Flood clusters, *Rainfall-runoff relationships.

A statistical model for the times of occurrence and the magnitudes of flood peaks is developed. The model is based on two-level and two-dimensional nonhomogeneous point stochastic process. The two levels correspond to the rainfall clusters and the flood clusters. The two dimensions are the times of occurrence (of the rainfall clusters or of the flood peaks) and the magnitudes (of the rainfall volumes or of the peak discharges). The statistical properties of the total number of flood peaks are developed in terms of the probability generating functional of the stochastic process. A statistical methodology is developed to estimate the two dimensional (time and magnitude) rates of occurrence of the precipitaton and of flood peaks. Data from several stations in Indiana were used for this purpose. The theoretical rate of occurrence, the theoretical covariance density and the probability mass function of the process are compared to the empirical rate of occurrence, the empiricai covariance density and the empirical probability mass function of the flood data. The results of this statistical comparison are satisfactory for the analyzed stations.
W83-02143

THE MIXED GAMMA MODEL FOR CHANNEL LINK LENGTHS,
State Univ. of New York at Buffalo. Dept. of Geography.
A. D. Abrahams, and A. J. Miller.
Water Resources Research, Vol 18, No 4, p 1126-1136, August, 1982. 5 Fig, 5 Tab, 36 Ref.

Descriptors: *Channels, *Model studies, *Frequency distribution, Computers, Mixing, Slopes, Streams, *Link lengths, Mixed gamma density, *Mixing distribution.

An investigation made of the lengths of exterior and interior links in 12 disparate areas suggests that link length distributions for most, if not all, natural landscapes represent a mixture of link length populations from different parts of the landscape charcterized by different ground slope and/or environmental conditions. The mixed gamma density is derived for link lengths by assuming that both the component link length distribution for each relatively homogeneous part of the landscape and the mixing distribution of weights assigned to the various component distributions can be represented by gamma distributions. The mixed gamma density satisfactorily fits 84% of the 70 link length distributions examined, compared with 67% fitted by the log normal and 59% fitted by the gamma density. Diviations from the mixed gamma density are largely ascribed to spatial distributions of slope and environmental conditions which give rise to non-gamma-mixing distributions. (Baker-FRC)
W83-02145

DYNAMIC PROGRAMMING APPLICATIONS IN WATER RESOURCES,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
For primary bibliographic entry see Field 6A.
W83-02147

EVALUATION OF THE REDUCTION OF THE VOLUME OF FLOW CARRIED BY CERTAIN RIVERS OF PUERTO RICO AND ITS POSSIBLE CORRELATION WITH CHANGES IN LAND USE, FROM 1508 TO PRESENT,
Puerto Rico Univ., Mayaguez. Dept. of General Engineering.
L. Pumarada-O'Neill.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178004, Price codes: A04 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Mayaguez, 1983. 54 p, 1 Fig, 2 Tab, 28 Ref, 2 Append. OWRT A-063-PR(1), 14-34-0001-0141.

Descriptors: *River flow, *Flow rates, *Land use, Urbanization, Land development, Runoff, Precipitation, *Puerto Rico, *Historical studies, *Statistical studies.

Historical evidence and oral accounts seem to indicate that there has been a significant reduction in the flow of many rivers in Puerto Rico. Several possible causes for this phenomenom have been mentioned, including the well documented, slight, but significant decrease in the average rainfall since the 1930's, the diversion of flow for irrigation and human water consumption, and the changes in land use that have taken place in the island. After an analyses of part of the existing historical evidence, which is found to be inconclusive, this paper undertakes a statistical study of available data for certain rivers in Puerto Rico. The hypotheses of the decrease in rainfall and in river volume of flow are tested, as well as the possible effect of land use changes in the basin upon the river's flow. The statistical analyses suggest that, within the period and basins studied, a decreasing precipitation may have cancelled an increasing proportion of run-off resulting from land use changes to avoid significant variations in volumes of flow.
W83-02215

REGIONAL ANALYSIS OF DROUGHTS IN SOUTH EASTERN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Chemical Engineering.
M. F. Pedraja-Santos.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178020, Price codes: A03 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Mayaguez, 1983. 28 p, 19 Fig, 2 Tab, 14 Ref. OWRT A-069-PR(1), 14-34-0001-1141.

Descriptors: *Droughts, *Hydrologic budget, *Meteorology, *Puerto Rico, *Regional analysis, *Time series analysis.

The time-series of stream flows for the five major streams in the area under consideration are presented in the study. Among them, only Rio Grande de Patilla's data corresponds to actual measured flows. All the other stream-flows were calculated from the average annual precipitation in the basin area. The average annual precipitation on the basin area was calculated using Thiessens method. In the case of the Rio de Maunabo stream the long-term annual mean flow was assumed for those years for which neither the stream flow or precipitation record was available. Thus, it was assumed that during those years there was no period of drought. For each stream the severity and magnitude of droughts are shown plotted against the exceedence probability. The long-term mean annual flow, the number of drought period of 'i' duration for each stream, the mean drought duration, mean failure probability and the 'i' year failure probability are shown in tables for each stream. According to the results the stream basin with the probabilty of having droughts of more than one year duration is the Rio Humacao basin, followed by the Rio Guamani and Rio Grande de Patillas basin. The latter had the greatest tendency of drought of 2-years to be extended or prolonged. The mean drought duration for the above basins are 3.07, 2.46 and 3.4 years respectively. (Munoz, Puerto Rico)
W83-02217

APPLICATION OF THE FINITE-ELEMENT METHOD TO CALCULATION OF UNSTEADY FLOW BY SAINT VENANT EQUATIONS,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. K. Kantorovich, and L. S. Kuchment.
Water Resources (English Translation), Vol 8, No 6, p 584-591, November/December, 1981. 4 Fig, 7 Ref. Translated from Vodnye Resursy, No 6, p 45-53, November-December, 1981.

Descriptors: *Rivers, Flow, Mathematical equations, Model studies, *Saint Venant equation, *Finite element method, *Algorithm, *Unsteady flow.

An algorithm developed for numerical integration of Saint Venant equations on the basis of one of the modifications of the finite-element method in combination with Galerkin's method is presented. The results of using the algorithm when calculating unsteady flow in two river stretches whose water regime were calculated earlier by finite-difference methods are given. The calculations of the unsteady regimes on the Delaware and Tvertsa rivers and also a number of numerical experiments show that with respect to accuracy and expenditures of computer time the finite-element method is completely competitive with the most commonly used difference methods of solving Saint Venant equations, which provides realization of its advantages following from the physical formulation of problems of river hydraulics. (Baker-FRC)
W83-02246

SYNTHETIC STREAMFLOW GENERATION 2. EFFECT OF PARAMETER UNCERTAINTY,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger, and M. R. Taylor.
Water Resources Research, Vol 18, No 5, p 919-924, August, 1982. 3 Fig, 1 Tab, 27 Ref.

Descriptors: *Streamflow, *Stochastic hydrology, *Model studies, *Delaware River, Reservoir storage, Reservoir releases, *New York, Probabilities, Parameter uncertainty.

The impact of incorporating the uncertainty in the statistics describing the distribution of annual flows into the streamflow generation process was examined. Using the 50-year flow record for the upper Delaware River basin, the uncertainty in the mean, variance, and correlation of annual flows had significant effects on estimates of the reliability with which reservoirs of different capacities can meet a specified demand. In fact, these uncertainties produced variations of the same magnitude as obtained using different models. Without compensating for the variation in mean and variance of annual flows, probabilities were 2.6% (Thomas-Fiering model) and 8.6% (ARMA annual) that a 50-year drought would occur. Probabilities were 10.2% and 18.2% considering parameter uncertainty. (Cassar-FRC)
W83-02270

SYNTHETIC STREAMFLOW GENERATION 1. MODEL VERIFICATION AND VALIDATION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger, and M. R. Taylor.
Water Resources Research, Vol 18, No 4, p 909-918, August, 1982. 3 Fig, 6 Tab, 45 Ref.

Descriptors: *Model studies, *Stochastic hydrology, *Streamflow, *Delaware River, Reservoir storage, Reservoir releases, *New York, Data verification, Data validation, Markov processes.

The performances of five monthly streamflow models were compared in the verification and validation of data for the upper Delaware River basin in New York State. A sharp distinction was made between verification (demonstration that a streamflow model produced flows with the specified characteristics of the selected distribution for river flow) and validation (demonstration that a streamflow model generates flow sequences producing reservoir system performance consistent with those generated from the historical flow record). The models included: Thomas-Fiering (1962) monthly Autoregressive Markov model, Autoregressive Moving Average (ARMA) monthly, Fractional Gaussian Noise (FGN) monthly, and the ARMA and FGN annual models using disaggregation to obtain monthly values. For each model the monthly and annual means, standard deviation, and skew coefficient of streamflow sequences are listed. (Cassar-FRC)
W83-02271

QUANTILE ESTIMATION WITH MORE OR LESS FLOODLIKE DISTRIBUTIONS,
Geological Survey, Reston, VA.
J. M. Landwehr, N. C. Matalas, and J. R. Wallis.
Water Resources Research, Vol 16, No 3, p 547-555, June, 1980. 2 Fig, 10 Tab, 12 Ref.

Descriptors: *Statistical analysis, *Flood frequency, *Distribution, Flood protection, Estimating, Wakeby distribution, *Gumbel distribution, Log normal distribution, Design floods.

Five techniques for determing flood distributions were used to determine the biases and mean square errors of the estimates of the upper quantiles for each of 6 Wakeby populations. These techniques were: Wakeby distributions with probability weighted moments; Gumbel distribution with probability weighted moments, maximum likelihood, and method of moments; and log normal with method of moments. Evidence that floods are distributed with long stretched upper tails suggested that use of the Gumbel and log normal consistently underestimated the extreme quantiles, resulting in underdesign of flood protection measures. None of the three Gumbel techniques performed consistently better than the other for all populations. The least underdesign was obtained with Wakeby distribution fitted by probability weighted moments. (Cassar-FRC)
W83-02273

A FREQUENCY DISTRIBUTION FOR ANNUAL FLOODS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
W. C. Boughton.
Water Resources Research, Vol 16, No 2, p 347-354, April, 1980. 8 Fig, 7 Tab, 6 Ref.

Descriptors: *Flood frequency, *Frequency analysis, *Statistical analysis, Flood recurrence, *Annual floods, *Australia, Distribution, Mathematical studies, Watersheds.

A distribution for frequency analysis of the logarithms of annual floods has been derived from data from 78 catchments in eastern Australia. The statistics of data from these catchments demonstrate the need for three-parameter distributions instead of two-parameter distributions for analysis of annual floods. A nonlinear relationship between frequency factor and ln ln (T/T-1) function of recurrence interval is demonstrated, and this relationship is used as the basis for the distribution. Methods of fitting the distribution to data sets, including sets which contain zero values, are described. A comparison is made of results from the new distribution, the log Pearson type 3, the log normal, the log Gumbel, and the Gumbel distributions. (Author's abstract)
W83-02276

ANALYSIS OF LENGTH DISTRIBUTION OF DRAINAGE BASIN PERIMETER,
California Univ., Irvine. School of Social Sciences.
C. Werner.
Water Resources Research, Vol 18, No 4, p 997-1005, August, 1982. 10 Fig, 18 Ref.

Descriptors: *Drainage basins, *Channels, Drainage, Basins, River basins, Water resources development, Topology, *Spatial distribution, Ridges, Mathematical equations, Maps, Model studies.

To establish a theoretical base for the study of the length distribution of basin perimeters, the paper introduces a descriptive model of the topology of interlocking channel and ridge networks. Assuming topological randomness within and between both, the expected number of links of basin perimeters is derived: for large basin magnitudes, n, it approximates a square root function in n. Observed link numbers of perimeters deviate significantly, showing a 0.69 regression exponent for their growth relative to the basin magnitude rather than the expected value of 0.5. The spatial constraint of possible perimeter/area to the 1/2 power proportions as defined by the circle is translated into a corresponding topological constraint but fails to provide a sufficient explanation. The possibility is then explored that the relatively large length of the perimeter reflects the basin elongation, which might be linked to the length of the mainstream. Although basin perimeter, elongation, and mainstream length are highly correlated and the elongation axis is oriented to the outlet in two-thirds of the sample basins, the data indicate that the mainstream link number does not account for the basin elongation, nor does it account for the number of links of the basin parimeter. (Author abstract)
W83-02287

A DERIVED FLOOD FREQUENCY DISTRIBUTION USING HORTON ORDER RATIOS,
Princeton Univ., NJ. Dept. of Civil Engineering.
C. Hebson, and E. F. Wood.
Water Resources Research, Vol 18, No 5, p 1509-1518, October, 1982. 7 Fig, 10 Tab, 32 Ref.

Descriptors: *Flood frequency, *Catchments, Catchment basins, Catchment areas, River basins, *Flood forecasting, Geomorphology, *Horton Order Ratios, Pennsylvania, Bald Eagle Creek watershed, Davidson River watershed, *Geomorphologic unit hydrograph, North Carolina, Appalachia Mountain region.

A flood frequency distribution is derived from assumed climatic distributions and the geomorphologic unit hydrograph model of catchment response. The derived distribution is tested on two Appalachian Mountain catchments and shows good agreement with historical data. Because the geomorphologic unit hydrograph (GUH) is rooted

in catchment shape and geomorphology, this derived frequency distribution may be a promising vehicle for studying the effect of catchment shape on flood frequency characteristics. Furthermore, it is suggested that the question of catchment homogeneity and similarity, necessary for regional flood estimation, can also be studied through the GUH derived flood distribution. (Baker-FRC)
W83-02347

A STUDY OF LOW FLOWS USING DATA FROM THE SEVERN AND TRENT CATCHMENTS,
J. Pirt, and J. R. Douglas.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 4, p 299-308, 1982. 5 Fig, 2 Tab, 5 Ref.

Descriptors: *Low flow, *Streamflow, *Minimum flow, Severn River, Trent River, Flow duration, Runoff coefficient, River flow, Residual flow diagram, *England.

Three methods of describing low flow information are the residual flow diagram, the natural runoff map, and flow duration curves. Residual flow diagrams give a hydrological snapshot of a river for a particular flow condition. It can show how the flow at any point is composed in terms of natural and artificial components and can indicate water quality. River flows, water reclamation works discharges, abstraction returns, and trade effluent returns are used to prepare quantity and quality diagrams, which plot the flow against the kilometer point of the river for given flow conditions such as dry weather flow and minimum flow. 200 such diagrams are available for rivers and tributaries in the Severn-Trent Water Authority area. Runoff coefficients are obtained by dividing the net addition to natural runoff between any two points by the contributing catchment area between those points. The coefficients are depicted on maps for minimum and dry weather flow conditions for the Severn and Trent basins. Flow duration curves can assess the frequency distribution of flows at any site lacking gaged data, given the catchment area, mean annual effective rainfall, geological type, and soil index. (Cassar-FRC)
W83-02388

A STATISTICAL ANALYSIS OF THE DAILY STREAMFLOW HYDROGRAPH AND A PROBABILITY DISTRIBUTION OF THE INTERARRIVAL TIMES OF PEAK FLOWS-APPLICATION TO INDIANA,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
M. L. Kavvas, and J. W. Delleur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187153, Price codes: A07 in paper copy, A01 in microfiche. Technical Report No 147, January 1983. 111 p, 41 Fig, 4 Tab, 24 Ref.

Descriptors: *Discharge hydrograph, *Stream discharge, *Probability distribution, Stochastic processes, Floods, Droughts, *Indiana, *Flood peak, Streamflows, Interarrival time.

A periodic analysis of the daily streamflows at five gaging stations in Indiana was performed to gain insight into the stochastic structure which governs the daily stream process. This analysis made use of the mean function and the covariance function of the daily streamflows as well as the probability distribution of the interarrival times between peak discharges and the probability distribution of the times to the peak discharges. It is shown that the daily streamflow process is annually periodic in all its statistic functions and that the persistence properties and the recession decay rates change with the state of the watershed storage and with time. An attempt was made to derive a theoretical probability distribution of the interarrival times between hydrograph peaks. These interarrival times and their probability distribution depend upon the time of the year and on the discharge exceedence level. The theoretical derivation is based on a stochastic trigger model of flood peaks. The derived distribution has limited success because of the averaging of the parameters over a relatively large interval of 15 days. It is believed that with a finer estimate of the parameter functions a better replication of the observed probability behavior would be obtained.
W83-02408

INVESTIGATION OF THE RELATION BETWEEN THE HYDROCHEMICAL AND HYDROLOGICAL REGIMES OF RIVERS OF THE AMUR BASIN,
For primary bibliographic entry see Field 2K.
W83-02442

2F. Groundwater

DIGITAL MODEL OF PREDEVELOPMENT FLOW IN THE TERTIARY LIMESTONE (FLORIDAN) AQUIFER SYSTEM IN WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
P. D. Ryder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-245804, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-54, 1982. 61 p, 17 Fig, 5 Tab, 44 Ref.

Descriptors: *Computer models, *Flow, *Aquifer systems, *Groundwater, Aquifer characteristics, Model studies, Simulation analysis, Wells, Water supply, Pumping, Groundwater movement, Potentiometric level, Regional Analysis, Geohydrology, Water management, *Florida, Floridan aquifer, Southwest Florida Water Management District.

A computer model was calibrated to approximate predevelopment flow conditions in a multilayered aquifer system in 10,600 square miles in west-central Floria. The lowermost aquifer, called the Floridan aquifer, is confined in most of the study area and consists of carbonate rocks ranging up to 1,300 feet thick. The Floridan aquifer is the chief source for large withdrawals and natural springflow in the study area. Daily springflows within the study area have averaged about 2.4 billion gallons. The secondary artesian and the surficial aquifers are much less permeable than the Floridan aquifer. Where they are present and have heads higher than those in the Floridan aquifer, they provide recharge to the Floridan. Initial estimates of recharge to the Floridan aquifer were from water-balance calculations for surface-water basins; initial estimates of transmissivity were from aquifer tests and flow-net analyses. The model was calibrated for the predevelopment era, wherein steady-state flow conditions were assumed. Calibrated transmissivities for the Floridan aquifer range from less than 15,000 to several million feet squared per day. Recharge to the system was about 3,700 cubic feet per second. About 90% was discharged as springflow, and 10% was upward leakage. (USGS)
W83-02113

APPRAISAL OF GROUND-WATER QUALITY NEAR WASTEWATER-TREATMENT FACILITIES, GLACIER NATIONAL PARK, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W83-02115

NITRATE-NITROGEN CONCENTRATIONS IN GROUND WATER FROM THREE SELECTED AREAS IN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
T. B. Spruill.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-255555, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-11, 1982. 32 p, 3 Fig, 9 Tab, 6 Ref, 3 Append.

Descriptors: *Nitrates, *Groundwater, *Water quality, *Data collections, Geology, Wells, Aquifers, Contamination, Drinking water, Geochemistry, *Kansas.

Nitrate-nitrogen data collected during 1976-79 from 333 wells in Kansas were summerized and statistically analyzed on the basis of area, aquifer, and well depth. Nitrate-nitrogen concentrations exceeding the 10 milligrams per liter mximum allowable concentration in public-water supplies were observed in 4% of the wells analyzed in western Kansas, 16% in central Kansas, and 29% in eastern Kansas. Concentrations exceeding 10 milligrams per liter generally occurred in wells less than 100-feet deep. Data indicate that nitrate-nitrogen concentrations in ground water greater than 10 milligrams per liter generally are derived from nitrogen sources at or near the land surface, although some soluble nitrogen may be derived from fine-grained sediments in some aquifers. Water from shales in central and eastern Kansas and limestones in eastern Kansas exhibited highest median concentrations and the highest incidence of concentrations greater than 10 milligrams per liter. Water from 10% of the wells in unconsolidated Quaternary deposits in western Kansas and almost 30% of the wells in eastern Kansas had nitrate-nitrogen concentrations that exceeded 10 milligrams per liter. Shallow wells in shales, limestones, and uncolsolidated Quaternary deposits are highly susceptible to nitrate contamination. Wells in unconsolidated Tertiary deposits produced water with a low incidence of concentrations greater than 10 milligrams per liter, indicating minimal contamination from sources at or near the land surface. Water from sandstone in all areas had the lowest median nitrate-nitrogen concentrations and the lowest incidence of concentrations greater than 10 milligrams per liter. (USGS)
W83-02116

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1982,
Geological Survey, Salt Lake City, UT. Water Resources Div.
W. F. Holmes.
Utah Division of Water Resources Cooperative Investigations Report 22, 1982. 85 p, 43 Fig, 3 Tab, 4 Ref.

Descriptors: *Groundwater, *Aquifers, *Withdrawal, *Water-level fluctuations, Water quality, Wells, Water use, Water supply, Irrigation, Geohydrology, Water table, Potentiometric level, Groundwater recharge, Hydrologic data, Precipitation, Surface-groundwater relations, Hydrographs, Maps, *Utah.

This is the nineteenth in a series of annual reports that describe ground-water conditions in Utah. The estimated total withdrawal of water from wells in Utah in 1981 was about 832,000 acre-feet, which was about 78,000 acre-feet more than in 1980 and 19,000 acre-feet more than the average annual withdrawal during 1971-80. The increase in withdrawal was due primarily to increases in withdrawal for irrigation. Total withdrawal for irrigation in 1981 was about 548,000 acre-feet, which is 54,000 acre-feet more than reported for 1980. Withdrawal for industry in 1981 was 85,000 acre-feet, which is 20,000 acre-feet more than reported in 1980. Withdrawal for public supply was 141,000 acre-feet, about the same as reported in 1980. Withdrawal for domestic and stock use in 1981 was 60,000 acre-feet, also about the same as reported in 1980. The below average streamflow in most parts of the State during 1981 resulted in below average recharge to the ground-water reservoirs. This, coupled with the increase in withdrawals for irrigation, resulted in declines in ground-water levels in most parts of the State from spring of 1981 to spring of 1982. The Sevier Desert, where surface-water supplies from reservoirs were about average and ground-water withdrawals below average, was the only area in the state where water levels generally rose. (USGS)
W83-02118

RECHARGE IN SEMIARID MOUNTAIN ENVIRONMENTS,
New Mexico Inst. of Mining and Technology, Socorro.
G. W. Gross.

Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173286, Price codes: A03 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute Report No 153, Las Cruces, June 1982. 36 p, 8 Fig, 23 Ref. OWRT B-059-NMEX(3), 14-34-0001 9123.

Descriptors: *Groundwater, *Recharge, Springflow, *Tritium, *Oxygen 18, *Deuterium, *Computer models, Precipitation, *Artesian aquifer, *New Mexico, *Isotype studies, Isotope hydrology, Groundwater/surface water interaction, Roswell artesian basin.

A systematic investigation of tritium activity in precipitation, surface water, springs, and ground water of the Roswell artesian basin in New Mexico, has been supplemented by hydrogeologic reconnaissance of spring systems; by various statistical correlations and spectral analysis of stream flow and water level records of observation wells; by spring discharge measurements; by stable isotope determinations (oxygen 18 and deuterium); and by numerical modeling of part of the basin. Two recharge contributions to the Principal or Carbonate Aquifer have been distinguished principally on the basis of their tritium label and aquifer response characteristics. A 'fast' recharge component, of relatively high tritium activity, consists of snowmelt and storm runoff and enters the ground water system mostly as leakage from surface drainages where these cross the karstic San Andres Formation. A 'slow' recharge component, low in tritium, is transmitted from the western mountains through formations underlying the San Andres. Near the western basin edge, this 'slow' component, in the form of springs and shallow ground water, also feeds effluent streams which, in turn, lose most of it to the San Andres aquifer where they cross karstic zones. Almost all basin waters (including deep ground water) fall close to the meteoric line of hydrogen/oxygen isotope composition, and this rules out a juvenile origin or appreciable bedrock interaction.
W83-02137

THE CARBONATE AQUIFER OF THE CENTRAL ROSWELL BASIN: RECHARGE ESTIMATION BY NUMERICAL MODELING,
New Mexico Inst. of Mining and Technology, Socorro.
K. R. Rehfeldt, and G. W. Gross.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173294, Price codes: A07 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute Report No 142, Las Cruces, February 1982. 136 p, 35 Fig, 18 Tab, 56 Ref, 1 Append. OWRT B-059-NMEX(1), 14-34-0001-9123.

Descriptors: *Groundwater flow, *Recharge models, Transmisivity, Mass balance, *New Mexico, *Groundwater recharge, Model studies, Simulation analysis, Computer models, *Aquifers, *Spatial distribution, Roswell Artesian Basin, Glorieta Sandstone, Yeso Formation, *Carbonate aquifers, Precipitation patterns.

The flow of ground water in the Roswell, New Mexico, Artesian Basin, has been studied since the early 1900s and varied ideas have been proposed to explain different aspects of the ground water flow system. The purpose of the present study was to delineate the spatial distribution and source, or sources, of recharge to the carbonate aquifer of the central Roswell Basin. A computer model was used to simulate ground water flow in the carbonate aquifer beneath and west of Roswell and in the Glorieta Sandstone and Yeso Formation west of the carbonate aquifer. The resulting spatial distribution of recharge strongly indicates that a major component of recharge to the carbonate aquifer is derived from the upward leakage of water from the underlying formation. The model results agree with tritium analyses which indicate that much of the water in the carbonate aquifer is relatively old. Principal conclusions include: 1. The percentage of precipitation that becomes recharge is about 7%. 2. The Yeso and Glorieta contribute much more water to the carbonate aquifer than previously reported. 3. Groundwater conditions along the east slope of the Sacramento Mountains have an impact on ground water conditions in the Roswell Basin.
W83-02138

A BASELINE STUDY OF OXYGEN 18 AND DEUTERIUM IN THE ROSWELL, NEW MEXICO, GROUNDWATER BASIN,
New Mexico Inst. of Mining and Technology, Socorro.
W. G. Gross, and R. N. Hoy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173302, Price codes: A06 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute Report No 144, Las Cruces, May 1982. 95 p, 11 Fig, 7 Tab, 31 Ref. 1 Append. OWRT B-059-NMEX(2), 14-34-0001-9123.

Descriptors: *Oxygen 18, *Deuterium, Recharge, *Artesian aquifers, Groundwater, Computer models, *New Mexico, *Isotope studies, Circulation patterns, *Precipitation patterns, High-mountain runoff, Roswell Artesian Basin.

The isotopic ratios of deuterium and oxygen 18 were measured in precipitation, surface, and ground water samples from the Roswell Artesian ground water basin in south-central New Mexico. The purpose was to determine recharge and circulation patterns. With minor exceptions, samples measured for this study conform to the meteroic water line. No exchange reactions with aquifer rock seem to have taken place. While the D vs. 180 values of precipitation are spread over the whole usual range of the meteroic water line, well and spring samples lie within a relatively narrow range. The narrow range of D and 180 indicates mixing effects which are ascribed to one or more of the following factors: long ground water flow paths; large temperature fluctuations affecting which overwhelm the influence of elevation on precipitation; two sources of atmospheric moisture; interaquifer leakage; and recharge from intermittent streams with the flow-length expanding and contracting over large distances. Ground waters in the southern part of the Basin seem to be on the average, heavier in oxygen 18 as compared to those from the northern part. This may effect a larger contribution of high-mountain runoff in the north. It is concluded that a more precise definition of circulation patterns on the basis of stable isotope differences will require a much greater sampling frequency in both space and time.
W83-02139

FACTORS INVOLVED IN EVALUATING GROUND WATER IMPACTS OF DEEP COAL MINE DRAINAGE,
Geraghty and Miller, Inc., Champaign, IL.
For primary bibliographic entry see Field 4C.
W83-02149

BAYESIAN ANALYSIS OF UNDERGROUND FLOODING,
Mining Development Inst., Budapest (Hungary).
I. Bogardi, L. Duckstein, and F. Szidarovszky.
Water Resources Research, Vol 18, No 4, p 1110-1116, August, 1982. 7 Fig, 1 Tab, 23 Ref.

Descriptors: *Flooding, *Groundwater, *Bayesian analysis, Mathematical models, Model studies, *Hungary, Algorithms, Mathematical studies, Aquifers, Tunnels, Construction, Karst, Karst hydrology, Hydrodynamics, Transdanubian region.

The spatial phenomenon of karstic flow into an underground space by means of a Bayesian stochastic model is described. Water inrush into underground works located under a karstic aquifer was studied. The random variables of the model are inrush yield per event, distance between events, number of events per unit underground space, maximum yield, and total yield over mine lifetime. Physically based hypotheses on the types of distributions are made and reinforced by observations. High parameter uncertainty stems from the random characteristic of karstic limestone and the limited amount of observation data. Thus during the design state, only indirect data such as regional information and geolgical analogies are available. Updating of this information should then be done as the construction progresses and inrush events are observed and recorded. A Bayes simulation algorithm is developed and applied to estimate the probability distributions of inrush event characteristics used in the design of water control facilities in underground mining. A real-life example in the Transdanubian region of Hungary is used to illustrate the methodology. (Baker-FRC)
W83-02158

HYDROLOGIC CHARACTERISTICS OF LIMESTONE IN NORTHERN PUERTO RICO IN RELATION TO DEPOSITIONAL ENVIRONMENTS AND DIAGENESIS,
Puerto Rico Univ., Mayaguez. Dept. of Geology.
G. A. Seiglie, and M. T. Moussa.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175257, Price codes: A06 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute, Completion Report, Puerto Rico Univ., Mayaquez, 1983. 98 p, 36 Fg, 50 Ref, 1 Append. OWRT A-044-PR(1), 14-34-0001-1141.

Descriptors: Hydrologic properties, *Limestones, *Diagenesis, Deposition, *Rock properties, Karst, Sedimentary rocks, *Puerto Rico, Tertiary limestone belt, *Oligocene rock, *Pliocene rock, Limestone formations.

The purpose of this work was to describe the stratigraphy and depositional environments of the Tertiary limestone belt, northwestern Puerto Rico and to determine their lineaments and sinkholes. The petrography, macrofossils and foraminifers of the Tertiary limestone formations were studied to determine the lithostratigraphic successions, biostratigraphy and the ancient environments. The lithology, the macrofossils and specially the foraminifers were used to study the depositional paleovironments of the northwestern Puerto Rico formations. The San Sebastian Formation was studied mainly with washed samples of soft rocks while the other formations were studied by means of thin sections of limestone. The distribution of foraminifers in relation to the ancient environments of northern Puerto Rico between these periods is described in detail. (Munoz-Puerto Rico)
W83-02180

INCORPORATION OF PRIOR INFORMATION ON PARAMETERS INTO NONLINEAR REGRESSION GROUNDWATER FLOW MODELS, I. THEORY,
Geological Survey, Denver, CO.
R. L. Cooley.
Water Resources Research, Vol 18, No 4, p 965-976, August, 1982. 13 Ref.

Descriptors: *Groundwater flow, *Nonlinear regression analysis, *Model studies, Prior information, Data collections, Permeability coefficient, *Regression analysis, Groundwater.

A method is presented to analyze cases where prior groundwater flow information of unknown reliability is available. The method is based on the assumption that the prior information is fixed, or invarient, for any particular analysis. This assumption allows an extension of the theory of ridge regression to be used to analyze the method theoretically. Two scales of prior information can be available. First, prior information having known reliability, that is, bias and random error structure, or second, prior information consisting of best available estimates of unknown reliability. A regression method that incorporates the second scale of prior information assumes the prior information to be fixed for any particular analysis to produce improved, although biased, parameter estimates. Approximate optimization of two auxiliary parameters of the formation is used to help minimize the bias, which is almost always much smaller than that resulting from standard ridge regression. It is shown that if both scales of prior information are available, then a combined regression analysis may be made. (Baker-FRC)
W83-02263

STOCHASTIC ANALYSIS OF SPATIAL VARIABILITY IN TWO-DIMENSIONAL STEADY GROUNDWATER FLOW ASSUMING STATIONARY AND NONSTATIONARY HEADS,
New Mexico Inst. of Mining and Technology, Socorro.
S. A. Mizell, A. L. Gutjahr, and L. W. Gelhar.
Water Resources Research, Vol 18, No 4, p 1053-1067, August, 1982. 7 Fig, 1 Tab, 29 Ref.

Descriptors: *Stochastic process, *Groundwater flow, Groundwater, Flow, Spatial distribution, Steady flow, Stationary process, *Monte Carlo Method, Mathematical studies, Simulation analysis.

Two-dimensional steady groundwater flow in a confined aquifer with spatially variable transmissivity T is analyzed stochastically using spectral analysis and the theory of intrinsic random functions. Conditions that ensure a stationary head process are derived, and using two convenient forms for the covariance function of the ln T process, the head covariance function is studied. In addition, the head variogram is obtained for a particular nonstationary case, and the asymptotic head variogram is derived under very general conditions. Results are compared to those from other studies for one- and two-dimensional phreatic flow and others for one- and three-dimensional confined flow. Multidimensional flow analysis results in a significantly reduced head variance. The head correlation remains high over much greater distances than in the ln T correlations. The variogram for nonstationary heads continues to grow logarithmically as lag distance increases, independent of the form of the input covariance in the nonstationary case. The conditions for stationarity are contrasted with the corresponding results obtained for the one- and three-dimensional cases of other researchers. The head variance calculated from the stationary theory agrees with that of previous Monte Carlo simulations. (Author's abstract)
W83-02264

TRAVELING WAVE SOLUTIONS OF SATURATED-UNSATURATED FLOW THROUGH POROUS MEDIA,
Cold Regions Research and Engineering Lab., Hanover, NH.
Y. Nakano.
Water Resources Research, Vol 16, No 1, p 117-122, February, 1980. 9 Ref.

Descriptors: *Porous media, *Groundwater movement, *Wave propagation, Saturated flow, Unsaturated flow, Water table.

Traveling wave solutions to the problem of saturated-unsaturated flow of water through a uniform porous medium are derived, and the regularity properties of the solutions are studied. It is assumed that the medium obeys Darcy's law for saturated flow and the extended Darcy's law for unsaturated flow. Singularity occurs in the higher-order derivatives of flux with respect to the space coordinate in the solutions at water tables. The water tables in the solutions can be interpreted as acceleration waves of the nth order where n is a positive integer in cases where gravity is present or absent. (Cassar-FRC)
W83-02266

DIFFUSIVITY, STORATIVITY, AND THE DUPUIT ASSUMPTIONS FOR PERIODIC FLOW IN A VERTICAL HELE-SHAW MODEL,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
J. A. Williams.
Water Resources Research, Vol 18, No 4, p 925-930, August, 1982. 6 Fig, 6 Ref.

Descriptors: *Flow, *Groundwater, *Mathematical equations, *Storativity, *Hele-Shaw model, Model studies, Groundwater waves, *Diffusivity.

The linear theory of shallow phreatic aquifers and the role of storativity are investigated by using data from a periodic flow in a vertical Hele-Shaw model. The results of the study indicate that the theory is valid for specific values of the length of the periodic fluctuation in the phreatic surface, the amplitude of the fluctuation applied at the boundary, and the average depth. These values are not necessarily the upper limits. It was also demonstrated that the storativity varies with depth and frequency and assumes a maximum value at the depth for which the dominant meniscus configuration produces a minimum specific retention. Additionally, analyses of amplitudes indicate that local variations in the storativity (some of the order of 50%) occur systematically without any significant effect on the theoretically predicted amplitude behavior. Consequently, the linear theory requirement of a constant diffusivity may be relaxed. (Baker-FRC)
W83-02268

A NOTE ON THE MEANING OF STORAGE COEFFICIENT,
California Univ., Berkeley. Lawrence Berkeley Lab.
T. N. Narasimhan, and B. Y. Kanehiro.
Water Resources Research, Vol 16, No 2, p 423-429, April, 1980. 1 Tab, 14 Ref.

Descriptors: *Storage coefficent, *Porous media, *Groundwater movement, Drainage, Pore pressure, Fluid flow, Hydrology.

The term storage coefficient and the related expressions, storativity, specific storage, and total compressibility, are frequently used in hydrogeology, petroleum engineering, and other fields. These parameters seek to express the quantity of water required to be added to or removed from storage in order to change (under conditions of drainage) the average hydraulic head or pore pressure of a porous material by a given amount. Originally introduced over 4 decades ago, the storage parameter is still used by many in the restricted sense of a coefficient occurring in the partial differential equation describing fully saturated flow. However, with significant increase in our computational abilities using powerful numerical integration techniques, there presently exists a need to have a more fundamental appreciation of the storage parameter as it relates to transient fluid flow in porous media. Such a fundamental approach requires consideration of the type of loading to which the porous medium is subject as well as certain conventions followed by various workers in actually defining the parameter. While no new derivations or results are presented, attempts are made to assemble in a single place the various ideas relevant to the storage parameter in order to obtain a generalized perspective. (Author abstract)
W83-02269

A STATISTICAL APPROACH TO THE INVERSE PROBLEM OF AQUIFER HYDROLOGY 3. IMPROVED SOLUTION METHOD AND ADDED PERSPECTIVE,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman.
Water Resources Research, Vol 16, No 2, p 331-346, April, 1980. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Aquifer characteristics, *Transimissivity, *Groundwater movement, Hydrologic models, Finite element method, Model studies, Statistical analysis.

Previous related papers presented a new statistically based approach to the problem of estimating spatially varying aquifer transmissivities on the basis of steady water level and flux data and illustrated the application of this method. The purpose of the present paper is to introduce a new efficient method of solution which works under a much wider range of conditions than the method previously employed. The new method is based on a variational theory developed by Chavent (1971), which is extended here to the case of generalized nonlinear least squares. The method is implemented numerically by a finite element scheme. The inverse problem is posed in terms of log transmissivities instead of transmissivities and is solved by a Fletcher-Reeves conjugate gradient algorithm in conjunction with Newton's method for determing the step size to be taken at each iteration. The new method has several advantages over the traditional approach: savings in computer storage and time, guarantee that computed transmissivities are always positive, and ability to disregard small errors in the model and in the flow rate and sink/source data. Two theoretical examples are included to demonstrate the ability of the new method to deal with artificial noise of a relatively large amplitude, derived from a given stochastic model. The results demonstrate that the inverse method may be capable of computing log transmissivity estimates with an error variance which is significantly smaller than that of the original log transmissivity data. Undercalibration and/or overcalibration may produce relatively poor results. (Cassar-FRC)
W83-02277

ANALYSIS OF FLOW THROUGH HETEROGENEOUS RANDOM AQUIFERS. 2. UNSTEADY FLOW IN CONFINED FORMATIONS,
Tel-Aviv Univ. (Israel). School of Engineering.
G. Dagan.
Water Resources Research, Vol 18, p 1571-1585, October, 1982. 2 Fig, 17 Ref.

Descriptors: *Flow, *Aquifers, Unsteady flow, Confined aquifers, Isotropy, Conductivity, Transmissivity, Porosity, Groundwater flow, Groundwater, Hydrologic equation, Physical properties.

In this study on the direct problem of water flow through a heterogeneous formation of random stationary and isotropic structure the case of unsteady flow was studied in particular. Two typical problems were considered: first the transient case in which the head is initially constant and subsequently starts to change, and second, the periodic case in which the average head gradient varies harmonically with time for an extended period. The main result of the study was the determination of the criteria which enable one to apply the simpler and well-developed steady state analysis to time dependent flows. It is emphasized that these criteria have been derived for unconditional probability distributions of the conductivity and storativity. The main effect of conditioning is in principle to relax these criteria and to render the steady state analysis applicable in a wide variety of situations. (Baker-FRC)
W83-02330

STOCHASTIC MODELING OF GROUNDWATER FLOW BY UNCONDITIONAL AND CONDITIONAL PROBABILITIES 2. THE SOLUTE TRANSPORT,
Tel-Aviv Univ. (Israel). School of Engineering.
G. Dagan.
Water Resources Research, Vol 18, No 4, p 835-848, August, 1982. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Groundwater flow, *Solute transport, *Stochastic hydrology, *Conditional probability, Anisotropy, Porous media, Transmissivity, Hydraulic conductivity, Analysis of variance, Fate of pollutants, Model studies, Aquifer characteristics, Chemical properties.

Solute transport in a heterogeneous formation subject to uncertainty in transmissivity and hydraulic conductivity was studied using a stochastic model. The approximate closed form solutions were derived for a solute pulse in an average uniform flow through a formation of unconditional stationary random transmissivity. The solute concentration in this case had a high degree of uncertainty, which was much less in cases where the solute input volume was large compared with the heterogeneity integral scale. The concentration expectation did not obey a diffusion type equation in the case of two-dimensional flows unless the solute body had traveled a distance larger than a few tens of the transmissivity integral scales. The distance was exceedingly large for many applications. Conditioning of transmissivity or hydraulic conductivity reduced variance, but only when measurements at a dense set of points were available. The traditional approach of predicting solute concentration by solving deterministic partial differential equations is highly questionable in the case of heterogeneous formations. (Cassar-FRC)
W83-02338

STOCHASTIC MODELING OF GROUNDWATER FLOW BY UNCONDITIONAL AND CONDITIONAL PROBABILITIES 1. CONDITIONAL SIMULATION AND THE DIRECT PROBLEM,
Tel-Aviv Univ. (Israel). School of Engineering.
G. Dagan.
Water Resources Research, Vol 18, No 4, p 813-833, August, 1982. 3 Fig, 26 Ref.

Descriptors: *Stochastic hydrology, *Groundwater movement, *Steady flow, *Conditional probability, Flow, Recharge, Wells, Aquifer characteristics, Analysis of variance, Model studies, Porous media, Hydraulic conductivity, Transmissivity, Anisotropy.

Groundwater flow in heterogeneous porous formations of large extent is modeled using a stochastic process. The formation properties (hydraulic conductivity and transmissivity) and the flow variables (head, specific discharge, solute concentration) are treated as spatial random variables subjected to uncertainty, rather than deterministic variables. The main purpose of the study is to analyze the influence of conditional probability of input variables on the statistical structure of the dependent variables. The unconditional probability density functions are assumed to be stationary-multivariate-normal, while conditioning accounts for the measured values at a few points in the formation. Two problems of groundwater flow are discussed: conditional simulation and the direct problem for steady flow. Perturbation approximations were used to obtain analytical results. In conditional modeling the measured values at a few points in the aquifer are kept fixed, and uncertainty prevails at all other points. Then statistical computations are performed for the subensemble of aquifers which preserve the measured values. As a result both input and output variables are nonstationary. Conditioning reduces the variance of the variables. (Cassar-FRC)
W83-02339

ADAPTIVE EXPLICIT-IMPLICIT QUASI THREE-DIMENSIONAL FINITE ELEMENT MODEL OF FLOW AND SUBSIDENCE IN MULTIAQUIFER SYSTEMS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman, C. Preller, and T. N. Narasimhan.
Water Resources Research, Vol 18, No 5, p 1551-1561, October, 1982. 6 Fig, 1 Tab, 29 Ref.

Descriptors: *Flow, *Model studies, *Aquifers, Aquifer characteristics, Groundwater flow, Groundwater, Permeability, Subsidence, California.

A quasi three-dimensional finite element model is presented for the analysis of groundwater flow and land subsidence due to pumpage in multiaquifer systems. In the model, aquifers are simulated with the aid of two-dimensional horizontal finite element grids. Each aquifer is connected to its neighbors above and below by one-dimensional vertical finite element strings which allow leakage to take place across aquitards and aquicludes. Land subsidence is modeled by varying the void ratio of each vertical element according to nonlinear version of Terzaphi's one-dimensional consolidation theory. A major feature of the new method is its ability to solve the finite element equations explicitly in one part of the mesh and implicitly in another part, depending on the ratio between the stability limit of each node and any given time step size. Since the hyraulic diffusivity of aquitards is usually very small compared to that of aquifers, it is often possible to solve the finite element equations explicitly for most, and sometimes all, aquitard nodes, This leads to a virtual decoupling of the aquifer equations during a given time step, which results in a significant saving of computer time and storage. (Baker-FRC)
W83-02352

ELECTRICAL RESISTIVITY-HYDRAULIC CONDUCTIVITY RELATIONSHIPS IN GLACIAL OUTWASH AQUIFERS,
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
D. W. Urish.
Water Resources Research, Vol 17, No 5, p 1401-1408, October, 1981. 6 Fig, 4 Tab, 34 Ref.

Descriptors: *Model studies, *Glacial aquifers, *Electrical studies, Geophysics, *Soil water, *Permeability coefficient, *Soil porosity, *Particle size, Aquifers, Sand aquifers, Groundwater potential, Pore size, Theoretical analysis, Interstitial water, *Rhode Island.

A three-phase parallel resistor model is proposed as a sound theoretical basis for relating apparent aquifer formation factors to pertinent hydrogeophysical parameters in homogeneous isotropic sand. The model explicitly includes parameters of pore water resistivity, grain size and shape, porosity, tortuosity, and intergranular surface conductance, and is supported by data from laboratory tests. The model shows that intergranular surface conductance is an important factor at small grain sizes and high pore water resistivities, serving to lower the apparent formation factor. The model also demonstrates that direct relationships between hydraulic conductivity and formation factors are weak in the normal range of pore water resistivity, showing a strong dependence on porosity. A simulated field curve relating the apparent formation factor to hydraulic conductivity compared favorably with the comparable curve from field data for 13 pumping test sites in southern Rhode Island when systematic variation of in situ porosity and aquifer layering effects were taken into account. Both theorectical and empirical results demonstrate a positive correlation between aquifer apparent formation factor and hydraulic conductivity; however, quantitative interpretation is imprecise due to nonuniqueness and inherent variation in important aquifer parameters, especially porosity. (Geiger-FRC)
W83-02354

BIBLIOGRAPHY ON GROUND-WATER RECHARGE IN ARID AND SEMIARID AREAS,
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 10C.
W83-02362

INFILTRATIN AND GROUNDWATER RECHARGE. TRITIUM: A DIRECT PROBE,
North Dakota State Univ., Fargo. Dept. of Chemistry.
R. D. Koob.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182097, Price codes: A05 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute, Fargo, Completion Report, March 1981. 78 p, 18 Fig, 8 Tab, 31 Ref, 1 Append. OWRT A-060-NDAK(1), 14-34-0001-9036.

Descriptors: *Groundwater recharge, *Recharge, *Water balance, *North Dakota, *Infiltration, Evaporation, Transpiration, Runoff, Soil moisture, Water table, *Tritium, Mining, Falkirk mining site.

The objective was to evalute the groundwater recharge rate on the Falkirk mining site in western North Dakota. Thornthwaite's water balance method was used. This method uses mean monthly temperatures to estimate potential evapotranspiration. In the original work, comparison of potential evapotranspiration with precipitation was used to classify different regions by climatic conditions. In 1948, Thornthwaite and Mather modified the method for application to problems such as surface runoff prediction and groundwater recharge rate evaluation. Although Thronthwaite's method does not include humidity, radiation or wind, it was judged to provide sufficiently accurate estimates of evapotranspiration to allow calculation of groundwater recharge rates given precipitation and runoff data. This judgment was made by comparing Thornwaite's method with the more comprehensive treatments of Jensen and Haise and the modified Penman method. All methods showed potential evapotranspiration to be greater than mean monthly precipitation during the summer months. This study showed that application of Thornthwaite's method predicted that no recharge occured during the period over which data were available. Physical measurements of soil moisture to depths below the root zone through the same period, however, indicate that recharge did occur. That recharge does occur is further substantiated by the failure of continuous use of the groundwater for domestic supplies to deplete the water table. The Thornthwaite method appears to be an adequate model.
W83-02367

MECHANISMS, DISTRIBUTION AND FREQUENCY OF GROUNDWATER RECHARGE IN AN UPLAND AREA OF WESTERN NORTH DAKOTA,
North Dakota Geological Survey, Grand Forks.
B. W. Rehm, G. H. Groenewold, and W. M. Peterson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182121, Price codes: A05 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute, Report of Investigation No 75, ND State Univ., Fargo, September 1982. 72 p, 18 Fig, 6 Tab, 36 Ref, 1 Append. A-061-NDAK(1), 14-34-0001-9036.

Descriptors: *Groundwater, *Groundwater recharge, *Piezometers, *Stable isotopes, *North Dakota, Soil water movement, Infiltration rate, Evapotranspiration, Surface-Groundwater relationships, Hydrogeology, Aquifer, Hydraulic conductivity, Soil moisture, Falkirk, Water wells.

Groundwater recharge mechanisms have been examined at a specific site in Western North Dakota. Estimates of groundwater recharge presented here are based on a network of piezometers and water-table wells within the study area near Falkirk, N.D. These data were supplemented with observations on evapotranspiration rates, soil moisture content changes, and stable isotope concentrations. Groundwater recharge takes place throughout the landscape at widely varying rates. The average areal groundwater recharge rate through the 150 km super 2 study area is on the order of 0.12 m super 3.yr super -1.m super -2 to 0.025 m super 3.yr super -1.m super -2. These recharge rates are for 1979 only. The spring of 1979 was the wettest spring of the decade of the 1970s, so the recharge rates are probably greater than the long-term, average groundwater recharge rate. The 1979 Falkirk groundwater recharge rates generally fall on the high end of the range of recharge values that have previously been reported from the Northern Great Plains. Stable isotope data indicate that much of the water at or above the water table during the spring resembles snowmelt or slough waters. The spatial distribution of recharge is largely dependent upon two factors--the size of surface depressions and underlying lithology.
W83-02370

PORE PRESSURES IN DEBRIS FAILURE INITIATION,
Washington Univ., Seattle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2G.
W83-02371

USE OF PROTOTYPE MODELING FOR ESTIMATING NATURAL GROUNDWATER RESOURCES,
Akademiya Nauk URSR, Kiev. Inst. Geologichnykh Nauk.
V. M. Shestopalov, and V. L. Boyarko.
Water Resources (English Translation), Vol 8, No 6, p 619-628, November/December, 1981. 3 Fig, 3 Tab, 13 Ref. Translated from Vodnye Resursy, No 6, p 97-109, November-December, 1981.

Descriptors: *Groundwater management, *Estimating, Similarity analysis, Mathematical equations, Water balance, Water supply, Water resources development, *USSR, Slopes, Podolian Upland.

The problems of estimating groundwater resources of a territory from the standpoint of the similarity

theory were investigated. The main characteristics of the method are the use of computer inspection of mathematical models of different complexity for the purpose of establishing the optimal structure of the model and the use of 'external' criteria for the quality of the structures being inspected. The study indicated that the dimensionless equation permitted making an interpolation prediction of the distribution of the runoff characteristics of the selected water-balance plots. An increase in the number of significant dimensionless numbers will make it possible to reduce the error of determining the values of the groundwater runoff being predicted. Thus the use of the similarity theory when estimating groundwater resources allows a more concrete and objective consideration of the available information on direct and indirect factors influencing their formation, which leads to an increase in the reliability of the results of investigations. The method is useful for predicting natural groundwater resources of large regions and individual areas or small basins promising for the practical use of groundwaters. (Baker-FRC)
W83-02418

TRITIUM IN GROUNDWATERS OF THE CENTRAL SECTION OF THE BAIKAL-AMUR MAIN LINE ROUTE,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 5B.
W83-02443

AN ELECTRIC MICROINTEGRATOR FOR SOLVING ONE-DIMENSIONAL UNSTEADY GROUNDWATER FLOW PROBLEMS,
Central Scientific-Research Inst. of Multipurpose Use of Water Resources (USSR).
M. O. Chaban.
Water Resources (English Translation), Vol 8, No 6, p 643-646, November/December, 1981. 1 Fig, 3 Ref. Translated from Vodnye Resursy, No 6, p 129-133, November/December, 1981.

Descriptors: *Groundwater movement, *Model studies, Infiltration, Leakage, Surface flow, Percolation, Groundwater mining, Water supply, Construction, Microintegrator, Measuring instruments, Mathematical equations.

An electric microintegrator combines such important properties as simplicity and accessibility for a wide range of specialists with the possibility of solving the majority of problems encountered in practical calculations of groundwater dynamics in multilayered beds with an inhomogeneous distribution of percolation properties, including consideration of leakage and infiltration for confined and free-surface flow in steady and unsteady regimes. The one-dimensional electric microintegrator is small and consists of five main units: the model of the bed, the unit of limiting conditions, the control unit, the measuring device, and the power unit. The initial data for modeling depends on its purpose. Calculation of the model begins with determination of the similarity scales. Modeling occurs practically instantaneously. The mathematical substantiation of one-dimensional electrical unsteady-flow modeling of percolation processes and the given methodological materials permit developing a new type of instrument. The simplicity of use and simultaneously the wide range of problems solvable in hydrogeologic calculations permit the wide introduction of microintegrators in practical calculations during surveying, designing, and operating water management objects in water supply, reclamation, construction, and mining. (Baker-FRC)
W83-02444

2G. Water In Soils

PASSIVE MICROWAVE SENSING OF SOIL MOISTURE UNDER VEGETATION CANOPIES,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 7B.
W83-02146

EFFECT OF THE METHOD FOR DETERMINING PORE SIZE DISTRIBUTION ON PREDICTION OF THE HYDRAULIC CONDUCTIVITY FUNCTION AND OF INFILTRATION,
Louvain Univ. (Belgium).
R. Ragab, J. Feyen, and D. Hillel.
Soil Science, Vol 134, No 2, p 141-145, August, 1982. 5 Fig, 12 Ref.

Descriptors: *Permeability coefficient, Soil properties, Mathematical equations, *Infiltration, Percolation, Hydrualic permeability, Permeability, Hydraulic profiles, *Pore size, *Hydraulic conductivity, *Mercury intrusion method.

Water desorption and mercury intrusion methods were used to characterize the pore size distribution of a sand, and the hydraulic conductivity-water content function was calculated. When used as input to an infiltration simulation model the hydraulic conductivity water content function obtained from the water desorption method resulted in a better prediction of actual wetting profiles than did the function from mercury intrusion. However, the results of the latter method could be made to match those of the former by use of an empirical correction factor. It appears, therefore, that the mercury intrusion method, which offers the advantage of speed, can be helpful in characterizing soil hydraulic behavior only if its results are appropriately adjusted. (Baker-FRC)
W83-02192

FINITE-DIFFERENCE SOLUTIONS OF THE INFILTRATION EQUATION,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
R. J. Kunze, and D. R. Nielsen.
Soil Science, Vol 134, No 2, p 81-88, August, 1982. 8 Fig, 2 Tab, 12 Ref.

Descriptors: Mathematical equations, *Infiltration, Soil water, *Vertical distribution, Rainfall infiltration, Groundwater movement, Leaching, Percolation, Seepage, Richards' equation, *Finite difference interative method.

An accurate, two-term solution of Richards' equation for one-dimensional vertical infiltration was obtained by a finite difference, iterative method (FINDIT). Wetting distances and soil water content distributions closely resemble those obtained by Philip with his series solution, which is extremely accurate at short times but fails to converge for long times. Solutions appear to be equally accurate for all times using the proposed procedure. Hence, the proposed procedure does not require additional approximations or matching factors to link separate analyses for short or long infiltration times. Because the solution equation consists of only two terms, the inflow is logically partitioned into matric and gravitational components. The matric component is expressed in a constant sorptivity term S, conceptually identical to the sorptivity S of Philip. The gravitational component is time-dependent and increases to a maximum value equal to the hydraulic conductivity at the soil surface as time approaches infinity. After appropriate coefficients have been determined, both matric and gravitational components of cumulative infiltration may be expressed independently by a logarithmic relationship that avoids the use of D and K functions and iterative computer procedures. (Baker-FRC)
W83-02193

REDOX POTENTIAL, OXYGEN DIFFUSION RATE, AND SOIL GAS COMPOSITION IN RELATION TO WATER TABLE LEVEL IN TWO SOILS,
Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen.
F. Callebaut, D. Gabriels, W. Minjauw, and M. De Boodt.
Soil Science, Vol 134, No 3, p 149-156, September, 1982. 9 Fig, 23 Ref.

Descriptors: *Water table level, Soil properties, *Oxygen depletion, *Oxidation-reduction potential , Acidity, *Soil gases, *Oxygen diffusion rates, Groundwater, Water supply, Crop yield, Aeration, Thermal properties.

Changes in several soil aeration indices (redox potential, soil gas composition, and oxygen diffusion rate) were measured as caused by different stagnating groundwater levels. The oxygen diffusion rate was related to the soil water pressure head, so that the aeration status of a soil profile could be determined from simple tensiometer readings. Under steady-state moisture conditions a decrease in oxygen content was reflected by an increase in carbon dioxide content. The redox potential was related to the soil pH. The oxygen diffusion rate increased when the water table was lowered. Only at water table depths of more than 50 cm did the oxygen diffusion rate at the 5-cm soil depth exceed the level at which aeration is considered sufficient to sustain vigorous root growth. Empirical relations are presented for calculating the aeration profile in soils from water pressure head measurements with tensiometers. Redox potential measurements did not reflect the soil aeration status in oxygen-rich environments. (Baker-FRC)
W83-02194

SIMULTANEOUS APPROXIMATION OF WATER CAPACITY AND SOIL HYDRAULIC CONDUCTIVITY BY PARAMETER IDENTIFICATION,
Colorado State Univ., Fort Collins. Dept. of Mathematics.
D. W. Zachmann, P. C. Du Chateau, and A. Kute.
Soil Science, Vol 134, No 3, p 157-163, September, 1982. 2 Fig, 3 Tab, 4 Ref.

Descriptors: Soil properties, Model studies, *Permeability coefficient, *Soil water, Mathematical studies, Mathematical models, *Water capacity, Soil characteristics, Unsaturated flow, Hyudraulic properties, Fluid mechanics, *Hydraulic conductivity.

Methods are sought by which the functions of water capacity and hydraulic conductivity can be simultaneously determined under a variety of flow situations by casting the problems as identification problems. Attention was directed toward formulating the problem so as to minimize the experimental effort needed to collect the data from which the solution is to be determined. Initially the method is appled to a relatively uncomplicated flow system, a homogeneous, one-dimensional, vertical column of soil that is allowed to drain under gravity from saturation. Initial and boundary conditions are prescribed on the system, sufficient to ensure that the governing flow equation will have a unique solution, and then cumulative discharge data is used to simultaneously determine the water capacity and hydraulic conductivity functions. Results of some numerical examples are presented. The distinctive feature of this study is that techniques of parameter identification are used to simultaneously determine both the water capacity and hydraulic conductivity functions of a soil. (Baker-FRC)
W83-02196

DISTRIBUTION OF PHOSPHORUS IN COLUMNS OF VERY SANDY SOILS AFTER LEACHING WITH WATER OR DIAMMONIUM PHOSPHATE SOLUTIONS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
R. C. Sorenson, and R. A. Wiese.
Soil Science, Vol 134, No 2, p 97-104, August, 1982. 3 Fig, 6 Tab, 18 Ref.

Descriptors: *Phosphorus, *Leaching, *Soils, Soil types, Sand, Infiltration, Percolation, Fertilizers, Agricultural chemicals, Potassium, Diammonium phosphate, Nebraska.

Columns of three sandy soils were leached with water after surface applications of diammonium phosphate (DAP) or with solutions containing DAP. Final concentrations of Bray and Kurtz extractable P and, for two soils, exchangeable K were measured. Substantial amounts of P and K were leached downward. Where large amounts of water were applied and DAP was added in dry form, some native P was removed from all soils. For the most part, the P distribution patterns were similar for the three soils, but the magnitude of effects of P and water (solution) rate varied. Gen-

erally, the amount of P extracted was linearly related to the amount of applied P, whereas it was curvilinearly related to the amount of applied water. Large amounts of K were leached through columns of one soil. The amount of extractable K remaining in the column was linearly related to P applied and logarithmically related to the amount of water (solution) applied. (Baker-FRC)
W83-02199

EFFECT OF THE ENERGY OF RAIN ON ITS INFILTRATION INTO SOIL,
Mowcow Inst. of Land-Management Engineers (USSR).
N. I. Il'in, A. M. Abramov, and A. G. Morin.
Water Resources (English Translation), Vol 8, No 6, p 652-654, November/December, 1981. 1 Fig, 1 Tab, 8 Ref. Translated from Vodnye Resursy, No 6, p 141-144, November/December,1981.

Descriptors: *Rainfall intensity, *Infiltration, *Soil moisture, Rainfall-runoff relationships, Energy, Rainfall infiltration, Rainfall penetration, Moisture gradient, Soil types.

The rate and duration of infiltration of precipitation into soil depend primarily on the hydrophysical properties of the soil and characteristics of the falling precipitation. An experimental study was made of the dependence of infiltration of water into various soil types on the structure of rain and its energy characteristics. The concept of structure of rain includes its intensity and the average size of drops. It is obvious that the decrease of the infiltration capacity under the effect of the energy of rain will be different for different soils and different states of cultivation. The proposed energy approach can be used in geological and ameliorative calculations of the start of overland runoff in the case of natural and artificial rain. (Baker-FRC)
W83-02249

APPLICATION OF RECENT RESULTS IN FUNCTIONAL ANALYSIS TO THE PROBLEM OF WETTING FRONTS,
Cold Regions Research and Engineering Lab., Hanover, NH.
Y. Nakano.
Water Resources Research, Vol 16, No 2, p 314-318, April, 1980. 16 Ref.

Descriptors: *Infiltration, *Soil water, *Wetting, Soil physics, Porous media.

Evidence is presented to support the view that wetting fronts in porous media with a finite propagation speed are generally singular surfaces. The term, singular surface, implies that some of the physical variables are discontinuous on this surface. Recent results in nonlinear functional analysis are cited as evidence. Although conclusions reached in this paper do not totally invalidate the traditional viewpoint (that wetting fronts in porous media described by Darcy's law are not singular surfaces), it is important to note that no strict mathematical proof of classical general solutions for this situation has yet been advanced. The viewpoint presented in this paper has been supported by mathematical proof in several concrete examples. (Cassar-FRC)
W83-02267

USE OF ATMOSPHERIC FLUOROCARBONS F-11 AND F-12 TO DETERMINE THE DIFFUSION PARAMETERS OF THE UNSATURATED ZONE IN THE SOUTHERN HIGH PLAINS OF TEXAS,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W83-02289

HYDRODYNAMIC DISPERSION DURING ABSORPTION IN A FINE SAND 2. THE CONSTANT FLUX CASE,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
K. K. Watson, and M. J. Jones.
Water Resources Research, Vol 18, No 5, p 1435-1443, October, 1982. 9 Fig, 1 Tab, 9 Ref.

Descriptors: *Dispersion coefficient, *Absorption, *Soil water, Sand, Hydrodynamics, Porous media.

Earlier work on hydrodynamic dispersion during absorption in fine sand under constant concentration conditions indicated that the dispersion coefficient was velocity dependent. The more exacting constant flux case using influent boundary fluxes of water from 3.28 times 10 to the minus 7th power to 1.05 times 10 to the minus 5th power was analyzed in this study. These values allowed the ratio of mechanical dispersion component of the dispersion coefficient to the molecular diffusion component to vary from 0.43 to 5.81. Computer-derived numerical solution results were within the scatter of experimental data, suggesting that the hydrodynamic dispersion coefficient is velocity dependent. A beta value (dispersion length) of 0.0001 m was used for this soil. (Cassar-FRC)
W83-02329

MACROPORES AND WATER FLOW IN SOILS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
K. Beven, and P. Germann.
Water Resources Research, Vol 18, No 5, p 1311-1325, October, 1982. 8 Fig, 3 Tab, 143 Ref.

Descriptors: *Macropores, *Water flow, *Infiltration, *Soil porosity, Reviews, Subsurface flow, Darcys law, Fate of pollutants, Porosity, Channeling, Capillary water, Piping, Cracks, Unsaturated flow, Saturated flow, Model studies, Flow rates, Flow velocity, *Reviews, Nonuniform flow, Vertical flow, Pore size, Pore water, Soil saturation, Soil structure, Soil water.

A literature review for macropores in soils concerns their occurence and their role in infiltration and subsurface storm flow. Macropores are important considerations in studying water flow through unsaturated soil. They are channels for rapid movement of solutes and pollutants through soils. Macropores have been defined by various authors as having capillary potentials greater than -0.1 to greater than -10.0 kPa or equivalent diameters of 730 to 10,000 microns. In this paper macropores are defined as structures, regardless of size, that permit channeling. Macropores may be formed by soil fauna, plant roots, cracks and fissures from shrinkage and weathering, and natural piping. Factors affecting macroporosity are weather (drought, freezing, intense rainfall, and flora and fauna alterations), long-term ecological changes (conditions affecting populations of mice and worms), and land use (plowing, compaction by grazing animals). Macropores may be formed within 1 or 2 years and may persist up to hundreds of years. Experimental and theoretical studies on the effects of macropores on infiltration and subsurface flow are discussed. After the initial stage, infiltration is not adequately described by approaches based on Darcy's law. Although macropores may make up a small portion of total soil voids, they may dominate vertical flow rates under some conditions. However, air entrapment in macropores may reduce infiltration. Two domain models (macropore and matrix) are available to describe infiltration, but they must be regarded as no more than exploratory. It is likely that a variable zone of saturation at the base of the soil profile will dominate lateral macropore flows through unsaturated soil in generating subsurface storm flows. In the saturated zone fast response depends on steep slopes and high hydraulic conductivity caused by macropopes. Where a high degree of connectivity between macropores exists, channeling can be considerable. Current models of subsurface flows involving macropores are highly speculative. A future task is to integrate the concepts of flow in capillary pores and macropores into one coherent flow theory. (Cassar-FRC)
W83-02345

ELECTRICAL RESISTIVITY-HYDRAULIC CONDUCTIVITY RELATIONSHIPS IN GLACIAL OUTWASH AQUIFERS,
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2F.
W83-02354

PORE PRESSURES IN DEBRIS FAILURE INITIATION,
Washington Univ., Seattle. Dept. of Geological Sciences.
N. F. Humphrey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182139, Price codes: A09 in paper copy, A01 in microfiche. Washington Water Research Center Publication No 45, Washington State Univ., Pullman, September 1982. 169 p, 45 Fig, 3 Tab, 52 Ref, 3 Append. OWRT A-108-WASH(1). 14-31-0001-1277.

Descriptors: *Bedrock depressions, *Soil wedge, *Pore-water flow, Pressure, Groundwater, Flow, Convergence, Water table, Saturated-unsaturated groundwater flow, *Pacific Northwest, *Finite element analysis.

Soil filled bedrock depressions, or soil wedges, with typical dimensions of less than 10 x 10 x 2 meters, have been identified as major initiation locations for debris of failures in the Pacific Northwest. The ultimate stability of a soil wedge is determined by the pore-water pressures generated during rain storms by the convergence of shallow ground-water flow into the bedrock depressions. Analysis of the flow convergence is complicated by two factors, which are that the convergence is intrinsically three-dimensional which dictates a numerical approach to the analysis, and that the flow into a depression does not constitute an isolated system, but is only a small element of the overall hill-slope hydrology. The complex geometry of the soil wedges necessitates the use of the finite-element technique in construction of the numerical simulation model of the pore-water flow. However, the finite-element method is constrained by the physical size of a non-linear problem and it is not at present possible to model an entire hillslope flow system in three dimensions and time. To simulate a section of a hillslope with the finite element model it is necessary to nest the three-dimensional model of the wedge region within a two dimensional model of the overall hillslope groundwater flow. This is achieved with an approximate analytical technique that is developed for the calculation of the transient water-table positions within a hillslope under storm conditions. The development of the analytic technique rests on the linearization of the flow equation and the application of linear systems theory for the subsequent solution. The approximation technique has restricted this study to steep hillslopes with shallow soils that overlie relatively low hydraulic conductivity substrates. Two-dimensional finite-element modeling was employed to check the accuracy of the approximation technique. The results of the flow modeling lead to generalizations about saturated-unsaturated groundwater-flow in hillslopes with shallow soils that are subjected to storms. The pore-pressure fields are used to estimate the factor of safety for a particular wedge failure, thus demonstrating a methodology that allows analysis of the stability of wedge locations under destabilizing factors such as heavy rainfall or loss of root strength due to logging.
W83-02371

TRAFFICABILITY FACTOR IN A SILTY CLAY LOAM SOIL,
Maine Univ. at Orono. Dept. of Agricultural Engineering.
J. Bornstein, and W. E. Hedstrom.
Transactions of the ASAE, Vol 25, No 5, p 1240-1244, September/October, 1982. 7 Fig, 2 Tab, 13 Ref.

Descriptors: *Soil types, *Trafficability, *Drainage, Subsurface drainage, Seasonal variations, Crop yield, Loam.

Subsurface drainage systems affect spring and fall trafficability, the timeliness of planting and subsequent crop harvest and yield on a silty clay loam marine soil. Drainage effectiveness and trafficability response were evaluated by mercury tensiometers for soil moisture, a cone penetrometer for soil strength, and a subjective walk-on trafficability index. Soil moisture and penetrometer resistance measurements were taken over the shallow drains spaces at 3, 6, and 12m, at the mid-point between

drains and at two comparable random locations in undrained plots. Trafficability developed more rapidly in the spring on a slowly permeable representative silty clay loam soil with drainage than on undrained plots. A good correlation was noted between soil moisture tension and soil strength in the 0-15 cm soil depth, which could be matched to soil readiness and thus to workday or trafficable conditions. Corn yields vs drainage for 1980, a year characterized by a dry spring, showed no significant difference between drainage and no drainage. Alfalfa in 1981, when drained plots were ready for cultivation 3 wk earlier than undrained plots, gave yields significantly greater for the drained over the no drainage treatment from two cuttngs. There was no difference between drained treatments. (Baker-FRC)
W83-02421

MODELING SOIL MOISTURE AND EFFECTS OF BASIN TILLAGE,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W83-02422

INVESTIGATION OF THE EFFECT OF PHYSICOCHEMICAL CONDITIONS AND TEMPERATURES ON THE INITIAL GRADIENT AND REGIME OF FLOW IN CLAYS,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
V. M. Gol'dberg, and N. P. Skvortsov.
Water Resources (English Translation), Vol 8, No 6, p 629-637, November/December, 1981. 4 Fig, 1 Tab, 20 Ref. Translated from Vodnye Resursy, No 6, p 110-119, November/December, 1981.

Descriptors: *Clays, *Subsurface flow, *Permeability, Soil water, Flow rates, Flow patterns, Flow measurement, Flow characteristics, Physicochemical properties, Temperature effect, Infiltration, Fluid mechanics, Hydrogeology.

Certain properties of the fluid enclosed in the pores of clays are cited in a brief review of the process of flow in clays and the mechanism of variability of their percolation properties under various physicochemical and thermodynamic conditions. A majority of published works supports the phenomenon of violation of Darcy's linear law in the region of small hydraulic gradients in the presence of clays. However, these works do not give an unequivocal answer to the question of the presence of an initial flow gradient in clays. The results of experimental investigations on the initial flow gradient suggest that during flow of a fluid in clays a linear flow law and independence of the permeability coefficient from the value of the gradient are noted in the region of large hydraulic gradients. The change from linear to nonlinear flow is manifested in a rather marked decrease of the rate of flow and permeability coefficient, which is not proportional to the rate of decrease of the hydraulic gradient. The value of the initial hydraulic gradient for the same clay is greater for fresh water and less for a chloride solution. The adsorption complex affects the value of the initial gradient. The temperature has an especially strong effect on the initial gradient. As temperature increases, the initial hydraulic gradient decreases, and at sufficiently high temperatures it apparently may not be manifested at all. These results permit the assumption that under deep aquifer conditions, clay strata can be permeable, under the effect of increased temperatures and highly mineralized chloride solutions which in turn can cause a more intense vertical migration of subsurface waters. (Baker-FRC)
W83-02443

2H. Lakes

PHYCOLOGICAL STUDIES IN LAKES ONTARIO, ERIE, HURON, AND SUPERIOR,
Canada Centre for Inland Waters, Burlington (Ontario).
M. Munawar, and I. F. Munawar.
Canadian Journal of Botany, Vol 60, No 9, p 1837-1858, 1982. 15 Fig, 9 Tab, 33 Ref.

Descriptors: *Phytoplankton, *Trophic level, *Species composition, Lakes, Great Lakes, *Lake Ontario, *Lake Erie, *Lake Huron, Lake Superior, Limnology, Biomass, Eutrophic lakes, Oligotrophic lakes, Species distribution, Seasonal variation, Chlorophyll a, Primary productivity, Productivity, Algae, Diatoms, Baseline studies, Lake classification, Lake basins.

Phytoplankton species compositions were studied for 12 years using standard indentification, enumeration, and data-handling techniques to provide a baseline for evaluating long-term trends. This paper is an overview of voluminous data on the phytoplankton assemblage. For each lake the following information is included: water quality parameters, mean distribution of phytoplankton biomass, total chlorophyll a, primary production, and species composition, as well as seasonal variations of the activity coefficient and the previously mentioned parameters in distinct regions of the lakes. Biomass and species composition reflected the current trophic status of the lakes. Biomass values (g per cu m) were: Erie, 5.3 in the western basin, 3.2 in the central basin, and 2.4 in the eastern basin; Ontario, 3.3 inshore and 2.6 offshore; Huron, 0.8; and Superior, 0.1. Seasonal peaks were observed in Erie and Ontario but not in Huron and Superior. Diatoms were the main group in all lakes except offshore Ontario, where green algae dominated. Lakes were tentatively classified: Superior, ultraoligitrophic; Huron, oligotrophic; Ontario, Mesoeutrophic; and Erie, eastern and central basins, mesoeutrophic, and western basin, eutrophic. (Cassar-FRC)
W83-02102

MAT-WATER PHOSPHORUS EXCHANGE IN AN ACID BOG LAKE,
Michigan Univ., Ann Arbor. School of Natural Resources.
F. F. Hooper, and L. S. Morris.
Ecology, Vol 63, No 5, p 1411-1421, 1982. 6 Fig, 2 Tab, 15 Ref.

Descriptors: *Lakes, *Chemical composition, *Phosphorus, Groundwater movement, Nutrients, Cycling nutrients, Chemical reactions, Evapotranspiration, Bogs, Sphagnum, Air pollution, *Bog mat, *Michigan, North Gate Lake.

By means of a series of mat-labeling experiments using P-32 and through the analysis of water budgets of the lake and mat, the exchange of phosphorus between a bog lake and its surrounding Sphagnum mat and the fate of mat phosphorus entering the limnetic zone of the lake were examined. Movement of phosphorus in the system was regulated to a large degree by decomposition profiles, water balance, and water density. Decomposition regimes and water density regulated the depth of movement, but water balance dynamics regulated time of phosphorus movement and the distance it moved to and from the open water. Loss of water during high evapotranspiration concentrated the soluble unreactive phosphorus (SUP) within the mat, but at the same time created a flow of lake water low in phosphorus into the mat. At increasing distances from the lake, dilution of SUP by lake water became progressively less, and there appeared to be some upward flow of the phosphorus-rich water from deeper strata of the mat. Thus a gradient in phosphorus concentration was established within the mat adjacent to the lake by evapotranspiration. Modification of the littoral zone brought about by the development of a Sphagnum mat not only strongly modified phosphorus flow patterns, but also created phosphorus storage and high concentrations of phosphorus at a variety of sites within the lake basin and mat. Compared to nonbog lakes, bog lake systems exhibit greatly reduced recycling of phosphorus because of reduced biological transformations and storage, which reduces physical recycle. (Baker-FRC)
W83-02106

A FAUNAL AND SEASONAL STUDY OF THE AQUATIC INSECTS IN TWO WATER ECOSYSTEMS IN SOUTH ARKANSAS - DEGRAY RESERVOIR AND THE UPPER CADDO RIVER,
Arkansas Water Resources Research Center, Fayetteville.
For primary bibliographic entry see Field 6G.
W83-02127

CHLOROPHYLL, PHOSPHORUS, SECCHI DISK, AND TROPHIC STATE,
Environmental Monitoring Systems Lab., Las Vegas, NV.
V. W. Lambou, S. C. Hern, W. D. Taylor, and L. R. Williams.
Water Resources Bulletin, Vol 18, No 5, p 807-813, October, 1982. 3 Fig, 3 Tab, 16 Ref.

Descriptors: *Lake classification, *Eutrophication, *Trophic level, *Chlorophyll a, *Phosphorus, *Secchi disks, Nutrients, Water quality, Color, Light attenuation.

The relationships between chlorophyll a, total phosphorus, Secchi disk depth, and trophic state were studied using data on 757 U.S. lakes collected during the EPA's National Eutrophication Survey (NES). Application of Carlson's equation relating summer Secchi disk depth to chlorophyll a to the 757 lakes resulted in a correlation coefficient of 0.56. This suggested that light attenuation due to non-chlrophyll suspensoids or dissolved color was more important in controlling the amount of chlorophyll a produced per unit of total P in the NES lakes than in Carlson's set of 147 lakes (correlation coefficient, 0.93). Forty-four lakes, chosen to represent a full range of water clarity, were ranked using 18 different trophic state measurements and single to multivariate indices and compared with rankings obtained from mean summer ambient total P and chlorophyll a. The trophic state measurements and indices were much more successful in ranking the lakes against total P than chlorophyll a. This indicated that many lakes have differences in trophic rankings depending on whether the ranking mechanism is based on primary nutrients or biological manifestations. Assuming that total P or Secchi disk depth and chlorophyll a have a constant relationship in all lakes can lead to false conclusions about trophic state and unnecessary mangement controls. In this study Secchi disk depth ranked the test set of lakes against total P as well as or better than many other, more complex methods based on chlorophyll a concentrations. (Cassar-FRC)
W83-02155

THE ROLE OF GIZZARD SHAD (DOROSOMA CEPEDIANUM) IN EUTROPHIC FLORIDA LAKES,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
T. L. Crisman, and H. M. Kennedy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175299, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 64, Univ. of Florida, Gainesville, 1982. 83 p, 21 Fig, 9 Tab, 104 Ref, 2 Append. OWRT A-041-FLA(1), 14-34-0001-0110 14-34-0001-1110.

Descriptors: Limnology ecology, Ecosystems, Fish, *Eutrophication, Aquatic productivity, Warm-water fish, Algal blooms, Food chains, *Florida, *Shad, Eutrophic lakes, Lake Eustis, Orthophosphates, Phytoplankton, Cyanophyta, Chlorophyta, Diatoms.

The function of gizzard shad (Dorosoma cepedianum) in Florida lakes was investigated through: 1) short-term stocking experiments, 2) in situ algal viability studies, and 3) a simulation model of fish, plankton, and nutrient interactions. Fish were stocked at natural and elevated densities in enclosures filled with lake water. Phosphorus forms, chlorophyll a, algal productivity, and phytoplankton and zooplankton composition and abundance were monitored for eight and seven days, respectively. Shad had no impact on chlorphyll, productivity, or algal abundance in either experiment. In the natural density experiment, a significant increase was noted for orthophosphate and its ratio to total phosphorus, while copepod abundance de-

creased significantly. No significant differences were noted in the elevated density experiments. Incubation of fish feces indicated that several species of blue-green algae remain viable after passage through the shad's gut. A simulation model indicated that the shad population of hypereutrophic Lake Eustis is a steady state and that present shad removal practices will have little impact on either fish or plankton communities. Our data suggest that shad promote eutrophication both through elevation of orthophosphate concentrations and differential digestion of diatoms and green algae. This fish is not a suitable biocontrol agent for phytoplankton in eutrophic subtropical lakes.
W83-02184

PRIMARY PRODUCTION IN THE BRATSK RESERVOIR AND FACTORS DETERMINING IT,
Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
O. M. Kozhova, and V. N. Pautova.
Water Resources (English Translation), Vol 9, No 1, p 82-92, January/February, 1982. 4 Fig, 2 Tab, 46 Ref. Translated from Vodnye Resursy No 1, p 128-138, January/February, 1982.

Descriptors: *Reservoirs, *Primary productivity, Productivity, Biomass, Aquatic life, Seasonal variation, Aquatic productivity, *Organic matter, Bratsk Reservoir, *USSR, Water pollution effects, Seston.

Special studies were made of primary production of organic matter in the region of the Balagan wide-water expanse at the facilities of the biological station of the Biological Research Institute, Irkutsk State University. The processes of primary production of organic matter were studied on the basis of long-term regime observations covering all seasons, including investigations of the hydrochemical, thermal, and light regimes and recording of the successions of phytoplankton communities, their biomass and content of the main pigments in seston. (Baker-FRC)
W83-02243

RELATIONSHIP OF WATER-EXCHANGE INDICES OF VALLEY RESERVOIRS,
Moscow State Univ. (USSR).
K. K. Edel'shtein.
Water Resources (English Translation), Vol 8, No 6, p 603-607, November/December, 1981. 1 Fig, 15 Ref. Translated From Vodnye Resursy, No 6, p 70-74, November-December, 1981.

Descriptors: *Reservoirs, *Water exchange, *Mathematical equations, Indices, Mozhaisk Reservoir, *USSR.

The most widespread indices of the average rate of internal water exchange in valley reservoirs are the relationships between the inflow of water into the reservoir or outflow from it and the volume of water present in it. These indices of the average rate of internal water exchange are based on the hypothesis of a cross-sectionally uniform displacement of water present in the reservoir before the start of the calculated period by the water that newly entered it from inflows. To find a method of calculating the average rate of water exchange capable of taking into account the entire diversity of the factors and processes controlling it, an attempt was made at statistical processing of the data of actual observations of the water and hydrochemical regimes of a typical valley reservoir. The Mozhaisk reservoir was selected as morphologically simple and elucidated by detailed and reliable morphometric, water balance, and hydrological and hydrochemical data. The variability over a territory of the average depth of lakes and reservoirs and average annual depth of runoff from the drainage basin of flowing water bodies indicates the predominance of the effect of azonal geomorphological factors on the rate of water exchange in reservoirs, especially in the phase of equilibrium of their water balance, which usually coincides with the low water period of the rivers feeding them. (Baker-FRC)
W83-02244

FLUCTUATIONS OF WATER LEVEL IN A CLOSED LAKE AND THEIR OPTIMAL PROBABILISTIC PREDICTION,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. E. Prival'skii.
Water Resources (English Translation), Vol 8, No 5, p 571-584, November/December, 1981. 3 Fig, 3 Tab, 28 Ref, Translated from Vodnye Resursy, No 5, p 5-21, November/December, 1981.

Descriptors: Water levels, *Lakes, *Statistical methods, Mathematical studies, Estimating, Predicting, *Probabilistic process, *Water level fluctuations, Fluctuations.

A statistical description of the fluctuations of the water level of a closed lake in the case of a steady inflow regime is given and the problem of prediction for the steady and unsteady cases is examined. In the steady regime one can obtain the solution in an explicit form for all most important characteristics of the level such as variance, correlation function, spectrum, and prediction error. (Baker-FRC)
W83-02245

SEASONAL ASPECTS OF THE SURFACE AND ADVECTIVE HEAT FLUXES OF KOOTENAY LAKE, BRITISH COLUMBIA,
National Water Research Inst., Vancouver (British Columbia).
R. C. Wiegand, E. C. Carmack, R. J. Daley, C. B. J. Gray, and S. Jasper.
Water Resources Research, Vol. 18, No 5, p 1493-1502, October, 1982. 12 Fig, 26 Ref.

Descriptors: *Seasonal variations, *Lakes, *Heat flow, Hydrologic budget, Heat budget, Heat balance, Physical properties, *British Columbia, Kootenay Lake, Temperature effects, Rivers, *Advection, Wind.

A description is given of the heat and water balances of Kootenay Lake, British Columbia. While the lake has a moderately high throughflow, the heat budget is more in character with a lake that is little influenced by rivers. The role of the rivers is highlighted in the thermal history of lakes. A contrast is drawn between Kootenay Lake and Kamloops Lake, British Columbia; the latter is a strongly riverine lake with a much greater heat budget. It is suggested that the riverine nature of lakes can be characterized using a renewal time that applies to that region of the lake lying above the base of the river plume. Further, the relative roles of advective and surface effects can be qualitatively described using a ratio of surface buoyance of wind energy to river production of turbulent energy. These parameterizations may prove to be useful descriptors in a lake classification system based upon riverine quality. (Baker-FRC)
W83-02331

LAKE BOTTOM DYNAMICS AND MORPHOMETRY: THE DYNAMIC RATIO,
National Swedish Environment Protection Board, Uppsala (Sweden). Water Quality Lab.
For primary bibliographic entry see Field 2J.
W83-02332

USE OF THE ISOTOPIC COMPOSITION OF NATURAL WATERS OF WESTERN TURKMEN SSR FOR DETERMINING THEIR ORIGIN,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2K.
W83-02441

TEMPERATURE STRUCTURE AND STATIC STABILITY OF BOTTOM WATERS OF LAKE BAIKAL,
Institut Zemnoi Kory, Irkutsk (USSR).
V. A. Golubev.
Water Resources (English Translation), Vol 8, No 6, p 607-619, November/December, 1981. 5 Fig, 30 Ref. Translated from Vodnye Resursy, No 6, p 75-89, November/December, 1981.

Descriptors: *Temperature effects, *Bottom water, *Lake Baikal, *USSR, *Stability analysis, Lakes, Deep water, Vertical distribution, Stratification, Distribution, Temperature gradient.

Factors influencing the vertical stability of deep and bottom waters of lakes are investigated. The vertical temperature gradients of bottom waters in the southern and middle Lake Baikal depression are close to zero or negative. The stability of bottom waters with such a temperature structure is very sensitive to nontemperature factors. Mineralization is the most important of them. To maintain static stability of the bottom waters in the indicated regions of the lake it is necessary that their mineralization not decrease with depth. A superadiabatic bottom increase of temperature is noted in the deepwater zone of northern Baikal. The geothermal data indicate a hydrothermal nature of this phenomenon. An analysis of the equation of state for the specific volume of water with consideration of an increase in density of waters during mixing indicates the possibility of accumulation of the discharging hydrothermal solutions in the bottom zone of the lake. The excess mineralization of the hydrothermal solutions relative to the Baikal waters apparently provided for static stability of the bottom waters in the depression. In a number of cases positive temperature gradients close in value to the geothermal were recorded in the thin bottom boundary layer of water in various regions. These may be due to conductive transfer of the earth's internal heat by water masses of Baikal. (Baker-FRC)
W83-02445

2I. Water In Plants

SOIL- AND ATMOSPHERE-INDUCED PLANT WATER STRESS IN COTTON AS INFERRED FROM FOLIAGE TEMPERATURES,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
S. B. Idso, R. J. Reginato, and S. M. Farah.
Water Resources Research, Vol 18, No 4, p 1143-1148, August, 1982. 6 Fig, 14 Ref.

Descriptors: *Water stress, *Plant water potential, Infrared thermometry, *Cotton, Temperature effects, Soil moisture, Moisture availability, Water potentials, Transpiration.

Foliage temperatures were obtained on cotton by means of infrared thermometry. These temperatures, along with air wet and dry bulb temperature measurements, were used to study certain relationships existing between the water contents of soil and air and the abilty of the crop to maintain transpiration at the potential rate. It was found that as soil water content was progressively depleted following an irrigation, departure from potential transpiration began to occur at smaller and smaller values of air vapor pressure deficit in a regularly predictable fashion. It was also noted that the plant water potential of cotton transpiring at the potential rate is a function of the air vapor pressure deficit and that the difference between this base value and the tension that develops under nonpotential conditions is a unique function of a newly developed plant water stress index. Finally, an example of the application of this foliage temperature based index to evaluating the effects of an irrigation event is presented. (Baker-FRC)
W83-02159

SOIL-VEGETATION-HYDROLOGY STUDIES, VOLUME II, A USER MANUAL FOR ERHYM: THE EKLAKA RANGELAND HYDROLOGY AND YIELD AND MODEL,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 2A.
W83-02314

SOIL-VEGETATION-HYDROLOGY STUDIES, VOLUME I. RESEARCH RESULTS, SUMMARY, DISCUSSION, AND RECOMMENDATIONS,
Agricultural Research Service, Sidney, MT. Northern Plains Soil and Water Research Center.

For primary bibliographic entry see Field 3F.
W83-02315

CONSUMPTIVE WATER USE RESPONSE OF MAIZE TO CHANGES IN ENVIRONMENT AND MANAGEMENT PRACTICES: SENSITIVITY ANALYSIS OF A MODEL,
California Univ., Los Angeles.
W. H. Terjung, J. T. Hayes, P. A. O'Rourke, J. E. Burt, and P. E. Todhunter.
Water Resources Research, Vol 18, No 5, p 1539-1550, October, 1982. 12 Fig, 4 Tab, 14 Ref.

Descriptors: *Evapotranspiration, *Model studies, *Soil-water-plant relationships, *Seasonal variations, Temperature effects, Soil types, Consumptive use, Wind, *Corn, Irrigation practices, Humidity, Water consumption, Crop yield, Groundwater.

WATER, a parametric crop water use model, employs climatic data to calculate water consumption for a variety of crops, using a modification of the Penman equation which included specific crop and growth stage effects. The response of WATER was demonstrated for a grain corn crop to changes in a variety of important environmental and decision-making inputs: air temperature, solar radiation, relative humidity, irrigation frequency, and amount of irrigation water applied. Five temperature, five solar radiation, and six relative humidity regimes were examined for an entire growing season. Also, five different water application schemes and four irrigation frequencies were included in the study. It was noted that evapotranspiration increased on the average by about 2.5% per degree increase in air temperature. One % change in solar radiation resulted in a 1.5% change in evapotranspiration, while a similar change in relative humidity caused a 0.4% response in evapotranspiration. Contrasting soil types, in addition to affecting irrigation frequency, were able to change the responding evapotranspiration by over 10%. (Baker-FRC)
W83-02340

EVALUATING A PORTABLE INSTRUMENT FOR DETECTING DROUGHT AND SALINITY STRESSES IN PLANTS THROUGH CHANGES IN LEAF OPTICAL PROPERTIES,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3F.
W83-02363

INCREASING RETURNS FROM WATER AND NITROGEN APPLIED TO IRRIGATED LANDS,
South Dakota State Univ., Brookings. Dept. of Plant Science.
For primary bibliographic entry see Field 3F.
W83-02406

2J. Erosion and Sedimentation

MANGANESE FLUXES FROM MISSISSIPPI DELTA SEDIMENTS,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
For primary bibliographic entry see Field 2L.
W83-02109

THE ROLE OF LAKE AND RESERVOIR SEDIMENTS AS SINKS IN THE PERTURBED GLOBAL CARBON CYCLE,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5B.
W83-02206

CALCULATION OF THE DEPOSITION OF RIVER SEDIMENTS ON THE NEARSHORE ZONE AND EVALUATION OF THE STABILITY OF THE SUBMARINE FAN,
Gruzinskii Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Tiflis (USSR).
V. V. Sakvarelidze, and S. S. Pirumov.
Water Resources (English Translation), Vol 9, No 1, p 76-82, January/February, 1982. 11 Ref. Translated from Vodnye Resursy, No 1, p 120-127, January/February, 1982.

Descriptors: *Sediments, *Rivers, *Sediment transport, Deltas, River sediments, Sedimentation, Currents, Waves, Fans.

A quantitative study was made of the processes of deposition of river sediments on the nearshore zone and formation of the depositional body. The problems of the deposition of river sediments on the nearshore zone were considered using the following two hypotheses when calculating the range of deposition of sediments: the sediments begin to be deposited from that site where the standard deviations of the vertical velocity fluctuation are less than the settling velocity of the sediments, and the longitudinal velocities of the water and sediment particles coincide. It was shown that the first hypothesis was valid only in those cases when the spreading jet did not lose contact with the bottom. In cases of spreading jet with detachment from the shore slope, particularly in the presence of a halocline, all beach-forming sediments regardless of the degree of turbulence of the spreading jet were deposited starting from the site of detachment. The second hypothesis was acceptable for all fine sediments with a diameter less than 4 mm. It was concluded that it is possible and expedient to reduce the volume of river sediments being transported to great depths of the nearshore zone by using a previously proposed sediment-retaining structure. This structure is intended for those rivers at the mouth of which there is no pronounced bar, or the bar is so thin that it is eroded by the current in an average flood and the river jet transports a large part of the sediments to the stepoff or to the canyon. (Baker-FRC)
W83-02251

ON WHY GRAVEL BED STREAMS ARE PAVED,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
G. Parker, and P. C. Klingeman.
Water Resources Research, Vol 18, No 5, p 1409-1423, October, 1982. 10 Fig, 2 Tab, 23 Ref.

Descriptors: *Sediment transport, *Gravel, *Streambeds, Bed load, Particle size, Grain size, Sand, Pavement, *Oregon, Oak Creek, Model studies.

The hypothesis is presented that pavement in poorly sorted gravel bed streams is a regulator that enables a stream to transport the coarse half and fine half of the bed load at equal rates, that is, pavement forms so that all available grain sizes are of nearly equal mobility. This involves exposing proportionately more coarse grains to the flow, since they are less mobile than fine particles. Field data from Oak Creek, Oregon, are used to quantify the concept and to develop river pavement grain size distributions. Size distributions of bed load and bed material are similar. The model predicts that sand bed streams should not have pavement, in agreement with observations. (Cassar-FRC)
W83-02272

UNSTEADY OVERLAND SEDIMENTATION,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. E. Croley, II.
Journal of Hydrology, Vol 56, No 3-4, p 325-346, April, 1982. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Sediment transport, *Fluid mechanics, *Hydrologic models, *Mathematical studies, *Sedimentation, *Rills, Rill erosion, Model studies, Hydrodynamics, Flow pattern, Overland flow, Mathematical models, Hydrographs, Channels.

Sediment flux to fluid flow in a rill may be physically modeled for simultaneous sediment entrainment, deposition and lateral inflow. Unsteady flow and sedimentation in overland rills are then described by continuity equations and approximations for flow, entrainment and transport capacity. The equations are reduced to one-dimensional equations of motion without sheet flow approximations. The method-of-characteristics solution to these equations for uniform excess rainfall yields the hydrograph and a three-part sediment concentration graph. The resulting model allows substitution of reasonable parameter values. When the flow is steady-uniform over infinite channel length or when the steady-uniform transport capacity concentration in the rill is equal to the lateral inflow concentration, sediment concentration is given by steady-uniform transport capacity equations. Boundary conditions on the first derivative of sediment concentration with time suggest constraints on the form of the equations for fluid flow, entrainment, and transport capacity which agree well with empirical results. Some general observations on the solution are made which describe the expected pattern of overland sedimentation. (Geiger-FRC)
W83-02283

THE USE OF REMOTE SENSING TECHNIQUES AND THE UNIVERSAL SOIL LOSS EQUATION TO DETERMINE SOIL EROSION,
Idaho Univ., Moscow. Dept. of Forest Resources.
K. M. Schuchard, and L. C. Tennyson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182006, Price codes: A03 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute, Moscow, Completion Report, January 1983. 25 p, 3 Fig, 22 Ref. OWRT A-080-IDA(1), 14-34-0001-2114.

Descriptors: *Soil erosion, *Remote sensing, *Landsat data, Agriculture, Forest and range lands, VICAR/IBIS image processing, COver type identification, Universal soil loss equation, Annual soil erosion, Annual soil loss tolerance, *Idaho, Hangman Creek.

Satellite data with ancillary watershed information was used to determine soil erosion of agriculture, forest and range lands in the southern portion of the Hangman Creek watershed, Benewah County, Idaho. Vegetation cover types derived from satellite data and the VICAR/IBIS image processing computer software package were determined with 89% accuracy. The vegetation cover types identified on the study area were dense-mixed forest, medium density mixed forest, ponderosa pine forest, wheat, lentils, barley, bluegrass, pasture and brush. Soil erosion (tons/acre/year) was estimated with the Universal Soil Loss Equation. Annual soil loss in the study area ranged from 0.003 tons/acre/year in the dense to mixed-forest cover type to 18.7 tons/acre/year in the wheat and lentil cover types. Annual erosion was compared with the annual soil loss tolerance to determine critical erosion areas.
W83-02326

LAKE BOTTOM DYNAMICS AND MORPHOMETRY: THE DYNAMIC RATIO,
National Swedish Environment Protection Board, Uppsala (Sweden). Water Quality Lab.
L. Hakanson.
Water Resources Research, Vol 18, No 5, p 1444-1450, October, 1982. 9 Fig, 5 Tab, 9 Ref.

Descriptors: *Sediment transport, *Bottom sediments, *Lake morphometry, Erosion, Sediment distribution, *Sweden, Lake basins, Lake beds, Lake sediments, Water depth.

This paper, a continuation of previous work, develops an improved formula for describing the relationship between lake bottom dynamics and lake morphometry. The areal distribution of erosion and transportation or accumulation processes at lake bottoms is governed by an energy factor (includes lake area and maximum depth), a slope factor (dependent on mean depth and lake area) and a form factor (dependent on maximum depth and mean depth). The term dynamic ratio equals the square root of lake area divided by mean depth. Application of this formula to empirical data from nine Swedish lakes confirms its improved accuracy. The model is not significantly improved by accounting for shore irregularity and/or lake slope. This model applies only to single basin lakes. In multibasin lakes each basin must be treated separately. The most accurate re-

sults are produced for lakes 1 to 5000 sq km in area. (Cassar-FRC)
W83-02332

MODEL EXPERIMENTS ON MOBILE, PAVED GRAVEL BED STREAMS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
G. Parker, S. Dhamotharan, and H. Stefan.
Water Resources Research, Vol 18, No 5, p 1395-1408, October, 1982. 12 Fig, 8 Tab, 13 Ref.

Descriptors: *Sediment transport, *Gravel, *Streambeds, Bed load, Particle size, Grain size, Pavement, *Oregon, Oak Creek.

The pavement in poorly sorted gravel streams is shown to be a mobile bed phenomenon, according to the results of laboratory flume studies. This type of pavement decreases the difference in mobility between large and small grains by exposing more of the larger grains to the flow. Pavement can coexist with the motion of all available grain sizes because only a small proportion of surface grains are in motion at a given time. Many particles constantly interchange with the pavement. The immediate subpavement particles move occasionally, and deeper particles rarely move. The flume experiments provide accurate quantitative models of field streams, obeying the same bed load laws. Either a sediment feed flume or a recirculating flume is usable for modeling. Natural streams, such as Oak Creek, Oregon, are usually a hybrid of the two types. (Cassar-FRC)
W83-02343

2K. Chemical Processes

BALANCE - A COMPUTER PROGRAM FOR CALCULATING MASS TRANSFER FOR GEOCHEMICAL REACTIONS IN GROUND WATER,
Geological Survey, Reston, VA. Water Resources Div.
D. L. Parkhurst, L. N. Plummer, and D. C. Thorstenson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-255902, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-14, 1982. 29 p, 10 Tab, 5 Ref.

Descriptors: *Computer programs, *Mass transfer, *Geochemistry, *Groundwater, Water sampling, Chemical reactions, Minerals, BALANCE, Fortran.

BALANCE is a Fortran computer designed to define and quantify chemical reactions between ground water and minerals. Using (1) the chemical compositions of two waters along a flow path and (2) a set of mineral phases hypothesized to be the reactive constituents in the system, the program calculates the mass transfer (amounts of the phases entering or leaving the aqueous phase) necessary to account for the observed changes in composition between the two waters. Additional constraints can be included in the problem formulation to account for mixing of two end-member waters, redox reactions, and, in a simplified form, isotopic composition. The computer code and a description of the input necessary to run the program are presented. Three examples typical of ground-water systems are described. (USGS)
W83-02114

CAUSES OF ACIDIFICATION OF FOUR STREAMS ON LAUREL HILL IN SOUTHWESTERN PENNSYLVANIA,
Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 5B.
W83-02136

ISOTOPIC COMPOSITION AND GEOCHEMICAL CHARACTERISTICS OF SUBSURFACE WATERS OF THE KRIVOI ROG BASIN AS INDICATORS OF THEIR INTERRELATION AND ORIGIN,
Akademiya Nauk URSR, Kiev. Inst. Geologichnykh Nauk.
I. F. Vovk, and V. I. Vysotskii.
Water Resources, Vol 9, No 1, p 15-21, 1982. 1 Fig, 4 Tab, 15 Ref. Translated from Vodnye Resursy, No 1, p 39-47, January-February, 1982.

Descriptors: *Geochemistry, *Brines, *Subsurface water, Krivoi Rog Basin, *USSR, Groundwater movement, Saline water, Mixing, *Isotope studies, Tectonics, Karst hydrology, Geohydrology.

A combination of traditional hydrogeochemical methods and isotopic methods was effective in determining the interrelation, origin, and exchange of groundwater in the Krivoi Rog iron ore basin in the Ukrainian Shield. The movement of groundwater is difficult to discern in this region because of deep recharge (to 900 m), ancient circulation of subsurface waters, mixing of subsurface waters, of different origin and age, and intense mining. The three vertical hydrochemical zones are: upper, slightly mineralized sulfate waters; middle, sulfate-chloride waters of increased mineralization; and lower, highly mineralized sodium chloride waters. The discharge of highly mineralized waters decreased rapidly after mining started; therefore, they were probably of tectonic and karstic origin. The primary brine with 330 mg per liter of salt originated in the Devonian salt-bearing stratum. Horizontal movement was negligible, and brines penetrated to considerable depths along faults and during tectonic activity. (Cassar-FRC)
W83-02247

PRINCIPLES OF ORGANIC CONTAMINANT BEHAVIOR DURING ARTIFICIAL RECHARGE,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W83-02405

USE OF THE ISOTOPIC COMPOSITION OF NATURAL WATERS OF WESTERN TURKMEN SSR FOR DETERMINING THEIR ORIGIN,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
L. G. Sokolovskii, and M. P. Ezhova.
Water Resources, Vol 9, No 1, p 10-15, January/February, 1982. 4 Tab, 11 Ref. Translated from Vodnye Resursy, No 1, p 33-38, January/February, 1982.

Descriptors: *Isotope studies, *Saline lakes, *Groundwater movement, Brines, Mixing, *USSR, Chemical composition, Salt flats, Subsurface water, Lakes, Geochemistry, Lake Karashor, Uzboi bed, Lake Kurtysh-Baba, Lake Molla-Kara, Kara-Bogaz-Gol Strait, Turmken SSR, Surface-groundwater relations.

Isotopic compositions of surface and subsurface waters were determined in several regions of western Turkmen SSR: the northern salt deposit of the Karashor depression, lakes of the Uzboi bed (Kurtysh and Molla-Kara, which lie in a bed that formerly connected the Aral and Caspian Seas), Kara-Bogaz-Gol strait and gulf, and flowing wells draining water from Jurassic-Neocomian and Upper Cretaceous deposits. The Karashor brines, found everywhere under the seasonally-deposited layer of salt, had low Ca, I, and Li levels and were depleted in radium and enriched in U. Results caused a revision of former estimates of depth of circulation of waters discharging in this area. Both groundwater and precipitation participate in formation of salts. The four-basin, clear Lake Kurtysh-Baba had higher temperatures at depths greater than 1.5 m than at the surface. This was not caused by discharge of thermal waters but by reflection of solar rays from the salt crystal (gypsum) bottom. Mineralization generally increased with depth. Isotopic composition of the groundwater and lake waters showed that lake recharge came from groundwater with low mineral content. The higher mineral levels in the lake bottom were produced by evaporation. Chemical analysis of Lake Molla-Kara and associated subsurface waters showed that both groundwater (Jurassic) and water from deeper horizons, emanating as jets from faults, were feeding the lake. The Kara-Bogaz-Gol Gulf brines were derived from evaporation of Caspian Sea water and from subsurface waters from Cretaceous deposits. (Cassar-FRC)
W83-02441

INVESTIGATION OF THE RELATION BETWEEN THE HYDROCHEMICAL AND HYDROLOGICAL REGIMES OF RIVERS OF THE AMUR BASIN,
G. N. Pogodaev, and G. V. Tsytsarin.
Water Resources, Vol 9, No 1, p 37-44, January/February, 1982. 4 Fig, 3 Tab, 9 Ref. Translated from Vodnye Resursy, No 1, p 74-82, January-February, 1982.

Descriptors: *Runoff, *Geochemistry, *Surface-groundwater relations, Water quality, Amur River, *USSR, Rivers, Ions, Chemical properties, River flow, Flow, Groundwater, Calcium, Bicarbonate, Mathematical equations.

The normal ionic runoff was computed for about 40 rivers in the Amur Basin, USSR, for each month. The index of ionic runoff varied from 6.02 to 63.32 tons per sq km per year. The higher values of 22.21-63.32 tons per sq km per year were found in basins subject to waterlogging. The volume of river discharge dominated the changes and seasonal dynamics of the ionic runoff. Minimum values were noted in February-March. Maximum concentrations of runoff occurred during the period of monsoon rains and snowmelt. The peak of ionic runoff usually coincided with peak discharge. Ionic runoff in downstream reaches was greater than in upper reaches. Groundwater hydraulically connected with the rivers did not contribute minerals to the river during the spring and summer-fall floods. Bicarbonate (0.16-1.97 meq per liter) dominated the anionic component and Ca (0.03-1.33 meq per liter) dominated the cationic component. An equation is given for calculating the chemical composition of water and ionic runoff for rivers. (Cassar-FRC)
W83-02442

2L. Estuaries

MANGANESE FLUXES FROM MISSISSIPPI DELTA SEDIMENTS,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
J. H. Trefry, and B. J. Presley.
Geochimica et Cosmochimica Acta, Vol 46, No 10, p 1715-1726, 1982. 9 Fig, 4 Tab, 45 Ref.

Descriptors: *Minerals, *Flux, *Sediment transport, Sediments, Sedimentation, River sediments, River, Deltas, Mississippi River, *Mississippi River Delta, *Manganese, Gulf of Mexico.

The hypothesis that diffusive manganese fluxes from rapidly accumulating Mississippi Delta sediments provide excess Mn to the deep Gulf of Mexico at the expense of Delta sediments was investigated. It was noted that massive sediment deposition on the Mississippi River Delta established reducing conditions sufficient to bring about Mn dissolution in the top few millimeters of sediment. As a result, significant fluxes of dissolved Mn pass from the Delta sediments to the overlying water column. This process was examined by a study of chemical partitioning of Mn in river particulates and Delta sediments and from interstitial water chemistry. Remobilized Mn is accurately transported away from the Delta area with aluminosilicate detritus, thereby providing the excess Mn to the deep Gulf waters. (Baker-FRC)
W83-02109

RIVERINE TRANSPORT OF NUTRIENTS AND DETRITUS TO THE APALACHICOLA BAY ESTUARY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. F. Elder, and H. C. Mattraw, Jr.
Water Resources Bulletin, Vol 18, No 5, p 849-856, October, 1982. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Nutrients, *Organic matter, *Flooding, Detritus, Organic carbon, Leaves, Litter, Apalachicola River, *Florida, Forest watersheds, Flood plains, Nitrogen, Phosphorus, Wetlands, Estuaries, Rivers, River flow.

Nutrient fluxes from the Apalachicola River basin to Apalachicola Bay, Florida, measured for a year (June 3, 1979, to June 2, 1980) were: total organic carbon, 210,000 metric tons; total nitrogen, 21,000 metric tons: and total phosphorus, 1,700 metric tons. About 15% of the 3100 sq km drainage area consists of bottomland harwood forest, from which nutrients and deritus are periodically removed by floding. Levels of total organic C and total N were 6-9 mg per liter and 0.75-1.0 per liter, respectively, remaining stable under a variety of flow conditions from 500 to 3000 cu m per sec. However, total P tended to increase with flow increases, from 0.02 mg per liter during low flows to 0.10 mg per liter during floods. The March 1980 flood discharge, 4 times that of the main outflow of 800 cu m per sec, carried higher organic loads than summer and fall flows. The 86-day spring flood accounted for 53, 60, 48, and 56% of the annual flux of total organic C, particulate organic C, total N, and total P, respectively. Timing of the floods with respect to leaf litter production was important. In 1980 the flood plain and leaves were first inundated in late winter-early spring. An autumn tropical storm could move large amounts of decomposed leaves to the bay. (Cassar-FRC)
W83-02153

ESTUARINE SEDIMENT CONTROLS ON TRACE METAL DISTRIBUTIONS,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W83-02175

THE SEDIMENTARY AND PHYSICAL DYNAMIC PROCESSES OF SELECTED ESTUARIES AND RIVER INLETS OF PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Marine Sciences.
J. Morelock, K. Grove, and M. L. Hernandez.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175240, Price codes: A04 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Puerto Rico Univ., Mayaquez, 1983. 68 p, 31 Fig, 6 Tab, 19 Ref. OWRT A-051-PR(1), 14-34-0001-1141.

Descriptors: *Sediment transport, *Estuaries, Rivers, *Deposition(Sediments), Sedimentary rocks, *Puerto Rico, Anasco-Mayaguez shelf, *Sediment distribution, Mud sediments.

Sediment deposition on the Anasco-Mayaguez shelf reflects sea level rise over a subaerially developed surface interacting with carbonate reef and river sediment sources. Wave and current patterns have played a role in distribution of the sediments. As sea level rose, a transgressive sea deposited blanket sands across the erosional surface and filled most of the submerging river channels. Coral reefs formed on local highs and contributed skeletal components to the sediment. Deepening sea level changed the character of the terrigenous deposits and reef sediments. As sea level approached the present level, patterns of modern sediment deposition began. In the modern environment, the dominant facies are the mud and sandy mud sediments from the rivers.
W83-02179

PHOSPHORUS AND ORGANIC CARBON IN THE SEDIMENTS OF A POLLUTED SUBTROPICAL ESTUARY, AND THE INFLUENCE OF COASTAL RECLAMATION,
Fisheries Research Station, Aberdeen (Hong Kong).
For primary bibliographic entry see Field 5B.
W83-02203

CALCULATION OF THE DEPOSITION OF RIVER SEDIMENTS ON THE NEARSHORE ZONE AND EVALUATION OF THE STABILITY OF THE SUBMARINE FAN,
Gruzinskii Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Tiflis (USSR).
For primary bibliographic entry see Field 2J.
W83-02251

SURVEY, ECOLOGY, AND SYSTEMATICS OF THE UPPER POTOMAS ESTUARY BIOTA: AUFWUCHS MICROFAUNA - PHASE III,
Georgetown Univ., Washington, DC. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W83-02291

SHELF AND SLOPE CURRENTS OFF NEWPORT BEACH,
Southern California Coastal Water Research Project Authority, Long Beach.
T. Hendricks.
In: Coastal Water Research Project, Biennial Report for the years 1981-1982, Willard Bascom, ed. p 247-257, 4 Fig, 3 Tab.

Descriptors: *Water currents, *Water depth, *Ocean bottom, *Flow rates, *Longshore currents, Outfall, Average flow, Flow velocity, Coastal waters, Coastal zone management, Variation coefficient, Current meters, Tidal currents.

The characteristics of the currents in the vicinity of an ocean outfall influence the dilution of the wastewater and the dispersion and sedimentation rates of effluent particulates to the ocean bottom. Current measurements on the shelf and slope area off Newport Beach were made to obtain data on mid-water and near-bottom currents; to determine the properties of the currents in deeper water (so the feasibility and advisability of extending outfalls can be explored); to examine inter-annual current variability; and to add to the data on currents in the southern California Bight. Current meter moorings were set at three locations in depths from 55 meters to 351 meters. Measurements were collected at mid-water and 1-2 meters from the bottom. Speed distributions were also recorded for median speed, most probable speed, etc. and at what depths they were observed. Near the bottom, net speeds were in the range of 1-3 cm/sec. Peak speeds tend to be higher on the shelf than in deeper water but this may reflect the longer record lengths available for the shelf area. A striking feature is that the current strengths at 250 meters (in 300 meters of water) are comparable with those at a depth of 40 meters in 55 metrers of water. Based on model studies comparing sedidentation rates of effluent particulates in the Newport Beach and Palos Verdes areas, it is expected that sedimentation rates could be enhanced at the slope station due to reduced cross-shore fluctuations and the effect of the sloping bottom. There is also the indication that although the net speed of mid-water flows at 150 meters are larger than on the shelf or lower on the slope, the near-bottom speeds are less than at other two sites. (Atkins-Omniplan)
W83-02307

ECOLOGICAL CHARACTERIZATION OF THE CENTRAL AND NORTHERN CALIFORNIA COASTAL REGION; VOLUME IV, WATERSHEDS AND BASINS.
Jones and Stokes Associates, Inc., Sacramento, CA.
Fish and Wildlife Service, Biological Services Program Report FWS/OBS-80/48-1 and -2, October 1981. In two reports, 1395 p 317 Fig, 381 Tab, 499 Ref. 14-16-0009-79-043.

Descriptors: Ecology, *Environment, *Estuaries, *Coasts, *Watersheds, *California, Geology, Hydrology, Water quality, Soil types, Distribution, Spawning, Anadromous fish, Social aspects, Economic aspects.

The study area includes coastal California from the Oregon border south to Point Conception and from the minus 1,000 m contour line offshore inland to the crest of the coastal mountain ranges. A separate chapter was prepared for each of 22 watersheds and five offshore basins; and each contains site-specific information. Chapters on the watersheds contain information on terrestrial, freshwater, and estuarine physical-chemical processes and features, biological resources, and socio-economic activities. Chapters about the basins contain information on intertidal, pelagic and subtidal benthic physical-chemical processes and features, biological resources, and socio-economic activities. Watershed chapters contain descriptions of geology, soils, climate, tsunami hazard, hydrology, water quality, and other topics. The biological resources section of each watershed description contains information on selected species and areas of ecological concern. Preserves, reserves, refuges, conservation areas, sites of known scientific and educational value, anadromous fish spawning areas, wild and scenic rivers, important nesting sites, and waterfowl and shorebird concentrating locations are described and mapped as areas of ecological concern. (Moore-SRC)
W83-02311

ALBEMARLE SOUND - TRENDS AND MANANAGEMENT NEEDS.
For primary bibliographic entry see Field 5G.
W83-02325

AMMONIUM IN THE DUWAMISH ESTUARY: NITRIFICATION, SEDIMENT RELEASE AND TOXICITY,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W83-02368

MATHEMATICAL MODELING AND PARAMETER IDENTIFICATION IN A TWO DIMENSIONAL ESTUARY: CASE STUDY OF THE HYDRAULIC MODEL OF THE SAN FRANCISCO BAY AND DELTA,
California Univ., Los Angeles. School of Engineering and Applied Science.
W. S. Chu, and W. W. G. Yeh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187146, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center, Contribution No 183, March 1981. 38 p, 10 Fig, 5 Tab, 47 Ref. OWRT B-191-CAL(3).

Descriptors: *Mathematical models, *Esturaries, Hydrodynamics, Tidal energy, Dispersion, Numerical analysis, Salinity, *California, *San Francisco Bay-Delta, Model studies, *Hydraulic models, Simulation analysis, Suisun Bay, Conjunctive use, Optimization.

This report presents a study of conjunctive use of mathematical and physical models for estuarine hydrodynamics and salinity transport simulation. Two sets of mathematical models are developed which are capable of simulating both the inter-tidal and intra-tidal conditions as represented by an existing, well-calibrated hydraulic model. Suisun Bay, a significant portion of San Francisco Bay, is selected as a study area for this project. Data collected from the physical model which contain relatively less noise are used to calibrate the mathematical models by an automatic optimization routine. The calibrated parameters are used for verification using a different set of data collected from the hydraulic model. Both calibration and verification compare favorably with observations. This report identifies a number of discrepancies in the general use of both mathematical and physical models based on the findings of this study. (Snyder-California)
W83-02407

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

NOVEL POLYMERS FOR REVERSE OSMOSIS MEMBRANES,

SRI International, Menlo Park, CA.
J. F. Wolfe, R. S. Jones, and P. D. Sybert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173237, Price codes: A04 in paper copy, A01 in microfiche. Technical Report, November 1982. 48 p, 16 Fig, 7 Tab. OWRT C-00139 -S(No 0465)(1), 14-34-0001-0465.

Descriptors: *Polymers, *Desalination, *Reverse osmosis, *Membranes, Thin film composite membranes, *Chlorine resistant membranes, Piperazine prepolymers.

A family of tertiary polyamide prepolymers was sought in an effort to develop new chlorine-resistant reverse osmosis (RO) membranes and to determine the relationship of the molecular structure and morphology of the membrane with its RO performance. Although the first two approaches did not give a general synthetic method from which a family of prepolymers could be prepared, three prepolymers (TRIPIP, DIPIP-10, and DIPIP-50) were synthesized and tested. A suitable method was found based on the synthesis of a tetramine monomer which has two of the amine groups protected. Polymerization with subsequent deprotection afforded an oligomeric polyamide with pendant piperazine groups spaced along the polymer backbone. Although the prepolymer afforded interfacial films for membrane studies, they were weak and did not adhere adequately to the polysulfone support. This method can be used to prepare membrane prepolymers with a variety of piperazine functionality, rigidity, hydrophilicity, and molecular weight. Techniques were developed for the preparation of thin film composite membranes (TFCM) by in situ reactions and identification of the important processing variables. Using polyethyleneimine/isophthaloyl chloride (PEI/IPC), the effects of varying PEI molecular weight were examined, and a variety of microporous polysulfone supports were studied. TFCMs were prepared using an oligomeric, piperazine-capped polyamide, DIPIP-50. These membranes were evaluated for chlorine resistance with both static and dynamic testing procedures. The testing mode proved to be critical in determining the membrane lifetime in an aqueous hypochlorite environment. DIPIP-50 based membranes do not exit adequate chlorine resistance under simulated working conditions.
W83-02132

PERMSELECTIVE MEMBRANES FROM POLYIMIDES AND AROMATIC POLYAMIDES,
Research Triangle Inst., Research Triangle Park, NC.
A. Schindler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178046, Price codes: A11 in paper copy, A01 in microfiche. Completion Report RTI/2063/00-01F, September 1982. 232 p, 61 Fig, 85 Tab, 29 Ref. OWRT C-00131-S(0464)(1), 14-34-0001-0464.

Descriptors: *Reverse osmosis, *Membrane processes, *Polymers, *Permselective membranes, *Desalination, Chlorine, Sodium hydroxide, Hyperfiltration, Polyimide membranes.

Reverse osmosis membranes possessing asymmetric morphology were fabricated from polyimides and polyamides of various chemical structures. These asymmetric membranes were characterized as to their morphology, chemical stability, thermal stability and hyperfiltration properties. The degradation of the polyimides derived from pyromellitic dianhydride and diaminodiphenyl ether (P-DDE) and diaminodiphenylether diphenylsulfone (P-SEDI) was studied in hot water, 10% sodium hydroxide and 5% sodium hypochlorite. The P-SED1 film was more stable to chlorine than the P-DDE film. P-SED1 was also more stable to sodium hydroxide. Overall, the reverse osmosis properties of the polyimide membranes indicated that as a class of polymers they are not very good candidates for desalination membranes. The aromatic polyamide structure- hyperfiltration property relationship was studied. Symmetrical aromatic diamines incorporated in the polyamide structure resulted in low flux, high rejection membranes. Asymmetric substituted aromatic diamines incorporated in the polyamide structure results in high flux and lower rejection. Methods for the preparation of high molecular weight N-substituted aromatic polyamides were evaluated. The N-methylated polymers prepared were observed to be poor materials for the fabrication of reverse osmosis desalination membranes. The polymer N,N'-piperzine-bis(4-hydroxybenzamide) exhibited excellent thermal stability and chlorine stability. (Moore-SRC)
W83-02222

3B. Water Yield Improvement

ECONOMIC ANALYSIS OF ALTERNATIVE DOMESTIC WATER SUPPLIES,
North Dakota State Univ., Fargo. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W83-02369

WATER AS A CONSTRAINT ON AGRICULTURAL DEVELOPMENT IN THE SEMI-ARID AREAS OF TANZANIA,
Dar es Salaam Univ. (Tanzania). Dept. of Geography.
J. D. Kaduma.
Water Supply and Management, Vol 6, No 5, p 417-430, 1982. 2 Fig, 2 Tab, 11 Ref.

Descriptors: Water resources development, *Irrigation water, *Groundwater availability, *Tanzania, *Semiarid lands, Agriculture, Evapotranspiration, Rivers, Drainage, Surface drainage, Water supply, Groundwater irrigation, Groundwater potential, *Developing countries.

Groundwater irrigation is regarded as the answer to stabilization of agriculture in semiarid areas of Tanzania. To date groundwater resources are not used on a widespread basis. Difficulties in developing this resource are the lack of data on groundwater location, depth, and quality; the extreme variability in lithology and structure; the existence of small, localized water bodies hard to detect by geophysical and satellite imagery; and lack of funds and experienced personnel. However, exploitation is possible because the igneous and metamorphic rocks underlying the semiarid zone are extensively weathered, fractured, faulted, and jointed to the depth of 150 m in some places. Other irrigation water sources are unavailable. Rainfall (200-800 mm a year) is very unpredictable and sporadic, precluding storage of runoff. The regions's two major rivers, Pangani and Great Ruaka, are regulated for hydroelectric power production, leaving very little water for irrigation purposes. Many streams, lakes, and swamps are ephemeral and/or brackish. The black clay soils impede drainage, crack when dry, and swell quickly upon wetting. The remainder of the soil is sand or sandy loam. Other factors inhibiting a stable agriculture are the large sections designated as national and state forest and game reserves; settlements built to take advantage of permanent waters, depriving nomads of their customary dry season watering places; and high evapotranspiration. (Cassar-FRC)
W83-02396

3C. Use Of Water Of Impaired Quality

EPIDEMIOLOGIC IMPACT OF WATER REUSE IN LOS ANGELES COUNTY,
California Univ., Los Angeles. School of Public Health.
R. R. Frerichs, E. M. Sloss, and K. P. Satin.
Environmental Research, Vol 29, No 1, p 109-122, 1982. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Public health, *Drinking water, *Recycled water, Groundwater recharge, Water shortage, Water supply development, Water conservation, Percolation, Advanced wastewater treatment, Water pollution sources, *Water reuse, Los Angeles County, *California.

The importance of recycled wastewater in the pathogenesis of disease has been considered in an ecologic analysis of four geographic areas of Los Angeles County. Two of the areas received recycled wastewater via the groundwater since 1962, while two similar areas served as controls. Of 19 health outcomes included in the analyses, five exhibited statistically significant differences among four areas. In none of these five analyses, however, were the differences in accord with the biologic hypothesis that recycled water causes disease. For only one outcome, deaths due to cancer of the rectum, were differences noted in which the high recycled water area had more excess deaths than the low recycled water area, and both had more excess deaths than the control areas. This positive association was of low order, however, and might have been due to chance. The results of this first stage of the study suggest that as of 1969-1971, there were no grossly apparent adverse health effects associated with the use of recycled water. Nonetheless, a cautious interpretation of the study findings is necessary due to the inherent limitations of this type of analysis. (Baker-FRC)
W83-02105

ECOLOGY AND PATHOLOGY OF WILDLIFE IN RESPONSE TO SPRAY IRRIGATION OF CHLORINATED SEWAGE EFFLUENT-PHASE II,
Pennsylvania State Univ., University Park. School of Forest Resources.
G. M. Kelly, J. S. Wakeley, W. H. Neff, H. Rothenbacher, and G. L. Storm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173260, Price codes: A05 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources, Pennsylvania State Univ., University Park, Completion Report, September 1982. 86 p. OWRT B-105-PA(4), 14-34-0001-8111.

Descriptors: *Effluent spraying, *Sewage effluents, Wildlife, Pathology, Ecology, Monitoring, Microenvironment measurements, Habitats, Birds, Mammals, *Pennsylvania, *Spray irrigation, *Faunal responses, *Wastewater irrigation, *Cottontail rabbits, Post-spray areas, Avian Community, Parasite incidence, Species, Strata.

Prior to chlorinated effluent spraying on a 200 ha area, research concentrated on developing techniques to monitor changes in wildlife populations and habitats and collecting a data base for comparison with post-spray information. Cottontail rabbits were radio-tagged and followed throughout the year. Home ranges, movements and habitat use were determined and microenvironment measurements were made at rabbit bedsites. Selected quantative histologic measurements were made and compared with various body and blood parameters to determine whether they could be used to define the health status of cottontail rabbits. Necropsied rabbits were examined for endoparasites, pathological changes and blood parasites. Differences in parasite incidence and pathology were found among seasons and between sexes and study areas. The ectoparasite fauna on cottontail rabbits from the study area was documented. Feulgen DNA and azure B RNA cytophotometry were used to do quantitative histochemical analysis of changes in nucleic acid levels in hepatocytes of cottontail rabbits. A study of the relationship between passerine bird distribution and abundance and vegetation present in the pre-spray area suggests the effluent spraying will probably impact the avian community. As understory and midstory vegetation change due to spraying, the numbers and distribution of species living in those stata will also change.
W83-02135

3D. Conservation In Domestic and Municipal Use

RESIDENTIAL WATER CONSERVATION IN A NONCRISIS SETTING: RESULTS OF A NEW JERSEY EXPERIMENT,

Wisconsin Univ.-Stevens Point. Dept. of Economics and Business.
D. J. Palmini, and T. B. Shelton.
Water Resources Research, Vol 18, No 4, p 697-704, August, 1982. 5 Tab, 13 Ref.

Descriptors: *Water conservation, *Municipal water, Water supply, Conservation, Water management, Domestic water, Resources management, Planning, *New Jersey, Cost savings.

A limited retrofit water conservation program conducted by a small suburban community in New Jersey is reviewed. The program started in 1980 by distributing to 564 households free packets of water saving devices purchased with municipal funds. The program was not a response to a current water supply crisis, and appeals for cooperation were based on the private economic benefits of water conservation. Statistical procedures were developed to measure the proportion of households installing each of the devices distributed, water savings and program costs. Two-thirds of the households receiving the packets installed at least one device. Average annual water savings per home receiving a packet were estimated at 5010 gallons (18.96 kl). Amortized over ten years at a 10% discount rate, the program cost was about 35 cents/1000 gallons of water saved. The results compared well to results obtained from similar conservation programs in a pair of California communities during the 1976-77 drought. (Baker-FRC)
W83-02157

CONSERVATION PRACTICES AND ATTITUDES AMONG MARYLAND WATER SUPPLY MANAGERS,
Maryland Univ., College Park. Dept. of Geography.
S. W. Sawyer.
Water Resources Bulletin, Vol 18, No 5, p 791-796, October, 1982. 22 Ref.

Descriptors: *Water conservation, *Water management, *Water supply, *Water demand, *Maryland, Surveys, *Attitudes, Water rates, Elasticity of demand, Water metering, Political constraints, Water policy, Institutional constraints.

A survey of managers at 35 Maryland water utilities indicates that they generally view conservation as a short-term response to temporary supply shortages. About 96% of all connections in the state are metered. About 1/3 of the managers have no sense of distribution of demand among residential, industrial, etc., sectors. Although most of the managers are not concerned with conservation programs, two large utilities (Howard County and Washington, D.C.) have comprehensive ongoing programs; 10 others occasionally use conservation measures. In case of a hypothetical 15% increase of demand, 14 of the 20 managers whose systems could not supply additional water favored an increase in supply capacity without conservation measures. Most managers do not approve of increasing step or block rate schedules to curb excessive water demand. Reasons for these attitudes are: (1) Maryland is seen as a water-rich area, (2) many systems have excess capacity because of firefighting regulations, (3) public opposition to conservation, (4) the association of conservation with reduced revenue and rate changes, and (5) low priority of water supply issues within the local governments. If water conservation is to be practiced widely in this region, the constraints affecting managers' attitudes must be addressed and the benefits of conservation must be better documented and communicated. (Cassar-FRC)
W83-02171

CONSUMER ADOPTION OF WATER CONSERVATION MEASURES: PERCEPTIONS AND INCENTIVES,
Southern Illinois Univ. at Carbondale. Dept. of Geography.
J. H. Simms, D. D. Baumann, J. J. Boland, A. Alley, and B. Kranzer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-180349, Price codes: A10 in paper copy, A01 in microfiche. Report, 1982. 200 p, 3 Fig, 51 Tab, 61 Ref, 4 Append. OWRT C-90210-C (No 9457)(1), 14-34-0001-9457.

Descriptors: Conservation, Pricing, Forecasting, *Consumer acceptance, *Water use, Climate, *Demand managment, *Water conservation, Arizona, Tucson, Colorado, Aurora, Illinois, Elmhurst, Indiana, Indianapolis.

The purposes of this study were to: First, identify factors that influence consumer adoption of water conservation measures; second, to determine the effectiveness of adopted conservation measures, that is, the extent to which they result in reduction in water use. Conservation measures were classified as voluntary residential, either behavioral (such as reduced lawn watering) or technological (such as low-flow toilets), or as community-imposed (mandatory). A stratified-random sample of 1383 residents from four cities was interviewed during the summer of 1980: data on 56 variables were obtained which included the aridity/humidity of the site, water management/conservation policies of the site, and specific characteristics of each respondent, such as socio-economic and demographic characteristics, personal ideology, personality, experience, perception of conservation measures, pricing policy, and crisis situation. The cities were selected on the basis of climate and water conservation policy. According to climate, Tucson and Aurora represent relatively arid sites: Elmhurst and Indianapolis represent more humid areas. And, according to water conservation policy, Aurora and represent more humid areas. And, according to water conservation policy, Aurora and Elmhurst are representative of cities with more active water conservation programs and polices with Tucson and Indianapolis being relatively less active in promoting water conservation. Most consumers were aware of a wide range of measures to reduce water; that is, the public is well-informed as to what to do to effect water conservation. The single most important factor accounting for the variation in consumer adoption of water conservation measures is climate. The individual socio-economic status was the next most important factor affecting the decision to adopt water conservation. In general, the higher one's socio-economic status, the more favorable is the attitude toward water conservation and the greater the likelihood that residential water conservation measures are implemented, especially those classified as technological. Attitudes toward community-imposed measures, however, are not significantly related to socio-economic status. Personality is an influential factor in attitude toward and the decision to adopt water conservation measures. The effect conservation has on water use is complicated. Only technological measures are related to reduced water used, and then only in communities with active water conservation programs--Aurora, Colorado and Elmhurst, Illinois. There was no relationship between the adoption of behavioral measures and water use in any of the four communities, and there was no relationship between the adoption of technological measures in Tucson or Indianapolis.
W83-02297

3F. Conservation In Agriculture

EVALUATION OF A LARGE SCALE IRRIGATION SYSTEM - DAIMCHEH, IRAN,
Jordan (Edward C.) Co., Inc., Portland, ME.
M. Miremadi.
Water Resources Bulletin, Vol 18, No 5, p 749-753, October, 1982. 1 Fig, 5 Ref.

Descriptors: *Irrigation efficiency, *Social aspects, *Developing countries, *Furrow irrigation, Daimcheh, *Iran, Water conservation, Sugarcane, Soil erosion, Erosion, Sprinkler irrigation, Flow control, Water loss.

The furrow irrigation system of the Karun Agro Industry, a sugar cane project in Daimcheh, Iran, was evaluated because efficiency had been reduced by 50% since its construction 8 years previously. The system was designed to cultivate 17,000 ha of land, using 3,000 field workers. Major difficulties were the workers (lack of skill, resentment toward nationalization of their land, poverty, falling asleep on the job), night irrigation (500 generators needed, local superstitions, furrow erosion), flow control (errors causing damage to canals), loss of water (evaporation, canal seepage, and failure to close gates to the river), and soil erosion (loss of the scarce organic matter, widening of canals, clogging of soil surface with silt). Suggested improvements in the system are sprinkler irrigation, replacement of quaternary canals with gated plastic pipes, training programs, better canal maintenance, increase of canal capacity to accomplish irrigation in 2 instead of 3 shifts, and incorporation of storage reservoirs. The project, which ceased to function after the political turmoil in Iran, was the target of shelling during the Iran-Iraq war. The extent of damage is unkown to the author. (Cassar-FRC)
W83-02151

SUPPLEMENTAL IRRIGATION OF HORTICULTURAL CROPS IN THE HUMID REGION,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
G. R. Sands, I. D. Moore, and C. R. Roberts.
Water Resources Bulletin, Vol 18, No 5, p 831-839, October, 1982. 9 Fig, 3 Tab, 15 Ref.

Descriptors: *Irrigation requirements, *Economic feasibility, *Cost-benefit analysis, *Supplemental irrigation, Crop yield, Model studies, Humid areas, Horticulture, Water distribution, Pipes, Wayne County, *Kentucky, Benefits, Tomatoes, Water stress, Water requirements.

A yield predictive computer model was developed to estimate water requirements for supplemental irrigation of horticultural crops (tomatoes, cabbages, peppers, and cucumbers) in humid regions of the U.S. The model consisted of several submodels: runoff, evapotranspiration-soil water, and stress index-yield. Four pipe distribution systems were designed for use in Wayne County, Kentucky, in a 4452 ha area containing widely distributed irrigated plots totaling 324 ha of horticultural crops. The systems were: (1) one pump serving the entire area of 324 irrigated ha, (2) one pump serving 259 irrigated ha, (3) one pump serving 65 irrigated ha in another section, and (4) two pumps, combining systems (2) and (3), serving 324 irrigated ha. The economic feasibility was determined for each design from capital, operational, and maintenance costs of the distribution and on-farm irrigation systems. None of the four systems proved feasible, assuming 4 acres-per-farm irrigation. However, upon increasing the area irrigated per farm and/or planting a greater percentage of high return crops such as tomatoes, the benefit-cost ratios could reach 2.9. The model predicted peak consumptive use rate for tomatoes of 6.5 mm per day at the 80% probability level. The average annual yield increase was 8.552 kg per ha, and the average seasonal water requirements were 95 mm. (Cassar-FRC)
W83-02172

ANALYSIS OF IRRIGATION PUMPING AND APPLICATION EFFICIENCY IN THE CENTRAL OGALLALA FORMATION,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
H. P. Mapp, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175331, Price codes: A06 in paper copy, A01 in microfiche. Oklahoma Water Resources Research Institute Completion Report, Oklahoma State Univ., Stillwater, January 1983. 104 p, 6 Fig, 34 Tab, 46 Ref. OWRT B-048-OKLA(1), 14-34-0001-9156.

Descriptors: *Water-use efficiency, Irrigation, Conservation, *Ogallala formation, Soil moisture stress, *Irrigation timing, Plant growth modeling, Economic evaluation, *Oklahoma, Panhandle region, Sorghum, *Optimal control procedures, Crop yield, *Irrigation scheduling, Water conservation.

This study evaluates irrigation technologies designed to increase pumping and application for irrigated grain sorghum in the Oklahoma Panhan-

dle region. A dynamic grain sorghum plant growth model is incorporated into a farm level simulation model to derive the effects of alternative irrigation schedules on crop yields, water use and producer net returns. Comparisons of proposed irrigation schedules is accomplished using stochastic efficiency and optimal control procedures. Stochastic dominance analysis is used to identify risk efficient irrigation strategies that realize greater net returns on the average and are less prone to low outcomes under unfavorable conditions. A number of irrigation strategies based on reduced water applications were found to dominate contemporary irrigation practices. Optimal control procedures are used to derive the quantity of ground water use through time which maximizes returns to the producer. Optimal control procedures indicate that producers can reduce water use by 30 to 40% while maintaining crop yields and the level of net return. If these efficiences could be achieved throughout the region, substantial reductions in ground water use would result and the economic life of the water supply would be lengthened.
W83-02188

IRRIGATION SYSTEM EFFICIENCY SURVEY FOR GEORGIA,
Georgia Coastal Plain Experiment Station, Tifton.
J. R. Stansell, C. Butts, K. Harrison, and J. Garner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177972, Price codes: A03 in paper copy, A01 in microfiche. Environmental Resources Center Report Number ERC 10-82, Atlanta, Georgia Institute of Technology, October 1982. 32 p, 6 Fig, 4 Tab, 10 Ref, 1 Append. OWRT A-102-GA(1), 14-34-0001-2111.

Descriptors: *Irrigation systems, Pumping, Standards, *Coefficient of uniformity, Application uniformity, *Center pivot systems, *Pumping systems, *Georgia, *Irrigation efficiency.

Fifteen pumping systems were tested for efficiency of operation and rated according to the performance criteria published by the University of Nebraska. Overall performance rating was 83.1% of standard. Six diesel powered systems were rated at 80.5% of standard while the average performance rating for nine electrical powered systems was 85.9% of standard. The range of all ratings was 44.1 to 122.0% of standard. The Christiansen and the Heerman-Hien coefficients of application uniformity were determined for seven center pivot systems. Average coefficients for the seven systems were 83.7 and 80.7% for the Christiansen and Heerman-Hein procedures, respectively. The range of coefficients was from 71 to 88%.
W83-02212

ANALYSES OF ENERGY USED BY IRRIGATION SYSTEMS,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
M. J. English, R. H. Cuenca, K-L. Chen, R. B. Wensink, and J. W. Wolfe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178055, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, June 1982. 102 p, 20 Fig, 24 Tab, 24 Ref, 6 Append. OWRT C-7133(6224)(1), 14-34-001-6224.

Descriptors: *Irrigation, *Energy, *Computer models, *Model studies, *Irrigation design, Economic aspects, Irrigation engineering, Deficit irrigation, Water conservation, Irrigation water, Water use, Sprinkler irrigation.

A model was developed to evaluate the total amount of non-renewable energy consumed in the irrigation process. This computer model is conversational in nature, asking certain questions about the system and feeding back answers so that the modeler can make further decisions as the design process continues. The model is capable of predicting energy requirements for the following irrigation systems: handmove, center pivot, drip, side role, solid set, surface, permanent, and big gun systems. The model was used to calculate energy requirements for manufacturing, transporting, installing, operating irrigation systems. A model was developed to compare optimum energy designs to minimum economic designs for farm irrigation mainlines. The standard rule of thumb for allowable head loss in mainlines may no longer be appropriate. An analysis of the relationship between energy used for pumping and irrigation uniformity considered sprinkler spacing, wind speed and the application pattern of sprinklers. For a particular sprinkler spacing, decrease in operating and total seasonal energy can be expected with increasing uniformity coefficients. The model was used to determine the effects of static pumping lifts on minimum energy and minimum economic designs. The model was also used to analyze an irrigation system designed for deficit irrigation. It appears that, under certain circumstances, deficit irrigation may reduce energy use and water use without appreciably reducing net income. (Moore-SRC)
W83-02224

USERS MANUAL FOR COMPUTER MODEL TO PREDICT TOTAL ENERGY REQUIREMENTS OF IRRIGATION SYSTEMS,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
M. J. English, R. H. Cuenca, K-L. Chen, R. B. Wensink, and J. W. Wolfe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178061, Price codes: A09 in paper copy, A01 in microfiche. Completion Report, June 1982. 189 p, 7 Fig, 5 Tab, 7 Ref. OWRT C-7133(6224)(1), 14-34-001-6224.

Descriptors: *Irrigation, *Energy, *Computer models, Irrigation engineering, Irrigation operation, Transportation, Head loss, Pumping, Sprinklers.

The model is capable of predicting energy requirements for eight irrigation systems: hand move, side roll, solid set, permanent, center pivot, surface, drip and big gun. The computer program continuously interacts with the irrigation analyst via a conversational input/output mode. Most standard irrigation systems can be analyzed by the model. The energy model contains 37 subroutines which determine total energy requirements by dividing each irrigation system into four basic energy-using activities: operating energy, manufacturing energy, transportation energy, and installation energy. Total dynamic head is found by summing calculated mainline friction head loss, calculated lateral friction head loss, specified sprinkler operating head, pump suction lift, elevation difference, friction loss, and height of the riser pump. The power required to pump water is determined from total dynamic head and pump discharge. Manufacturing energy is calculated by first determining the total weight of various materials in each component, then multiplying by the manufacturing energy embodied in each unit of weight of that material. Transportation energy is calculated as the sum of energy to setup the system each season and the energy required to move it during the season. Required inputs to the model include topographic information, irrigation schedule, assumed efficiencies, mainline configuration and configuration of the laterals. (Moore-SRC)
W83-02225

SOIL-VEGETATION-HYDROLOGY STUDIES. VOLUME I. RESEARCH RESULTS, SUMMARY, DISCUSSION, AND RECOMMENDATIONS,
Agricultural Research Service, Sidney, MT. Northern Plains Soil and Water Research Center.
E. L. Neff, and J. R. Wight.
Agricultural Research Results ARR-W-28, January 1983. 59 p, 19 Fig, 15 Tab, 44 Ref.

Descriptors: *Rangelands, Hydrology, *Contour furrows, *Range management, *Soil-water-plant relationships, *Montana, Precipitation, Snow, Runoff, Soil water, Vegetation, Sediment concentration, Water quality.

As part of cooperative research on rangelands with fine-textured soils conducted in southeastern Montana from 1968 to 1981, three research sites of about 40 acres each were selected in Carter County. Project site 1 was on a saline-upland range and sites 2 and 3 were on claypan range. Of the 16 2-acre watersheds constructed on the sites, 8 were treated by contour furrowing and 8 were left untreated. About 60% of the average annual precipitation each year occurred during 16 days in which daily rainfall was greater than 0.3 inch, 20% occurred as smaller storms, and 20% occurred as snow. Annual runoff from the untreated watersheds averaged about 5.7 inches from the saline-upland range site and about 4.0 inches from the claypan range site. Annual runoff from the contour furrowed watersheds averaged about 2 inches. Contour furrowing significantly increased soil water content by trapping snow and reducing runoff. Sediment concentration in runoff from the saline-upland site averaged about 1,700 ppm from both the untreated and contour furrowed watersheds. Sediment concentrations from both the untreated and contour furrowed watersheds on the claypan site averaged about 400 ppm. Contour furrowing on the claypan range sites increased average annual herbage yields 93% and 243% on sites 2 and 3, respectively. (Moore-SRC)
W83-02315

CONSERVATION IN LONG TERM CONJUNCTIVE USE: IRRIGATION DEMANDS USING DISAGGREGATE CHOICE MODELS,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 4B.
W83-02320

CONSUMPTIVE WATER USE RESPONSE OF MAIZE TO CHANGES IN ENVIRONMENT AND MANAGEMENT PRACTICES: SENSITIVITY ANALYSIS OF A MODEL,
California Univ., Los Angeles.
For primary bibliographic entry see Field 2I.
W83-02340

EVALUATING A PORTABLE INSTRUMENT FOR DETECTING DROUGHT AND SALINITY STRESSES IN PLANTS THROUGH CHANGES IN LEAF OPTICAL PROPERTIES,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
A. E. Hall.
California Water Resources Center Completion Report, Univ. of California, Davis, March 1983, 24 p, 8 Fig, 7 Tab. OWRT B-219-CAL(1).

Descriptors: *Water deficit, Irrigation, *Crop yield, Growth, Water use, Beans, Soil water, *Instrumentation, *Plant-water stress, Drought, *Irrigation management, *Leaf optical properties, Soil-water-plant relationships.

During the summer of 1981, a field experiment was conducted at Riverside, CA in which cowpeas were subjected to different levels of planned-water-deficit irrigation. Crop yield, growth, and water use were determined and methods for irrigation management, based upon weather, soil, and plant measurements, were compared. The experiment demonstrated that planned-water deficits, involving withholding irrigation from plant emergence to the first appearance of flower buds, substantially reduced water use from 102 to 179mm without affecting the yield of dry beans (a small yield increase of 3% was obtained compared with full season irrigation). During flowering and pod filling, the irrigation schedule which maximized water-use-efficiency while maintaining maximum yields subjected plants to a moderate water deficit. Nominal depletion of available soil water, estimated from predictions of crop water use, provided the most practical procedure by which farmers could manage irrigation of cowpeas. Tensiometers also provided adequate data for guiding irrigation. Pressure chamber, leaf conductance, canopy temperature, and near infrared reflectance measurements did not provide adequate data for guiding irrigation under commerical conditions. (Snyder-California)
W83-02363

INCREASING RETURNS FROM WATER AND NITROGEN APPLIED TO IRRIGATED LANDS,
South Dakota State Univ., Brookings. Dept. of Plant Science.
P. L. Carson, and D. L. Beck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187138, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Institute Completion Report, South Dakota State Univ., Brookings, December 1982. 40 p, 9 Fig, 10 Tab. OWRT B-063-SDAK(1), 14-34-0001-0249.

Descriptors: *Nitrogen, Nitrates, Nitrogen cycle, Demineralization, *Fertilizer requirements, *Corn, *Crop yield, *Irrigation practices, Computer models, *South Dakota, Model studies.

A field study was conducted in 1979 and 1980 to develop and test models predicting high yield irrigated corn response to nitrogen and water management techniques. Grain yield, leaf nitrogen content at silking and grain nitrogen content were predicted using fertilizer additions, soil nitrates in a 120 cm profile subsampled by depth, soil/water matric potential as measured by tensiometers and various other parameters. Percent attainment of maximum potential yield was also described in terms of leaf N and grain N contents as affected by soil/water matric potential. The models were developed at a researcher managed area using soil/water matric potential levels of -35, -50 and -75 kPa with fertilizer treatments of 0, 100, 200 and 400 kg/ha on this site testing low in soil nitrate. Soil matric potential, over the range tested, had no effect on the amount and N supplied by mineralization at that site. Yield, leaf N and grain N all increased as a cubic function with fertilizer additions. Leaf N and grain N increased as soil/water potential decreased. Grain yield increased as water potential increased. A yield of 13,500 kg/ha of grain was achieved at both the 200 and 400 kg/ha N levels under the -35 kPa water treatment. The atmospheric demand conditions of the two years were quite different causing a larger response to water treatment in 1979 than 1980. Seventeen cooperator sites varying in years irrigated from 0 to 14 were included in the study. Nitrogen balance techniques indicated that net mineralization did not differ substantially over these sites. The models developed were therefore testing using this data. Good to excellent predictive capability was shown with all models being significant at the .0001 level.
W83-02406

A MODEL FOR SPRINKLER NOZZLE REPLACEMENT,
Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
D. Karmeli, G. Peri, and M. Todes.
Transactions of the ASAE, Vol 25, No 5, p 1284-1289, September/October, 1982. 8 Fig, 4 Ref.

Descriptors: *Sprinkler irrigation, *Nozzles, *Maintenance, Cost analysis, Irrigation practices.

A model has been developed for sprinkler maintenance by periodic nozzle replacement. The model yields the optimal replacement time of regular nozzles and the optimal installation time of flow regulated nozzles, with respect to water wasted due to nozzle wear and pressure variation. These optimal times are dependent on sprinkler operating parameters such as the cost of the nozzle with respect to the cost of water, the discharge, the pressure, the lifespan of the sprinkler and the effective lifespan of the nozzle. For regular nozzles, savings in the range of 80 to 90% of the cost of water wasted due to nozzle wear can be achieved by regular nozzle replacement. For flow regulated nozzles, savings in the range of 90 to 99% of the cost of water wasted due to both nozzle wear and pressure variation can be achieved. (Baker-FRC)
W83-02420

MODELING SOIL MOISTURE AND EFFECTS OF BASIN TILLAGE,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
F. I. Idike, C. L. Larson, and D. C. Slack.
Transactions of the ASAE, Vol 25, No 5, p 1262-1267, September/October, 1982. 5 Fig, 5 Tab, 21 Ref.

Descriptors: *Soil moisture, *Basins, *Tillage, *Model studies, Water availability, Moisture availability, Water stress, Crop yield, Precipitation, Infiltration, *Corn.

Attempts were made to develop a model capable of predicting soil moisture levels in a field under corn production throughout the growing season and to determine by the use of this model whether basin tillage could increase soil moisture levels in areas where rainfall during the growing season is limiting. The model developed performed very well for most years, with the poorest predicted moisture content values for the year usually falling within 0.10 (vol/vol) of the observed values. The study concluded that the model satisfactorily predicted soil moisture levels in the field under corn production throughout the growing season and provided a basis for studying the effects of various practices on soil moisture. At both locations, application of the model indicated that the year round use of basin tillage increased soil moisture and decreased crop stress substantially as compared to conventional tillage. The increase in soil moisture content produced by basin tillage could be attributed to surface storage of excess precipitation during the growing season or the off-season, or both, depending on the location. (Baker-FRC)
W83-02422

CABLEGATION: III. FIELD ASSESSMENT OF PERFORMANCE,
Idaho Univ., Kimberly. Twin Falls Research and Extension Center.
M. C. Goel, W. D. Kemper, R. Worstell, and J. Bondurant.
Transactions of the ASAE, Vol 25, No 5, p 1304-1309, September/October, 1982. 10 Fig, 5 Ref.

Descriptors: *Flow rates, *Irrigation practices, *Cablegation, Runoff, Steady flow, Furrows, Irrigation ditches, Flow discharge, Runoff rates, Flow profiles, Ditches.

An evaluation is presented of performance of a cablegation system in terms of orifice discharges, advance of water with time in the furrows and flow into and out of the furrows. Furrow infiltration rates are also reduced as a function of time, and their interaction with the distribution system is discussed. Seventy-three percent of the water applied to the field infiltrated. Intake opportunity times averaged 11.0 hr at the top end and 8.3 hr at the bottom. The furrow intake rate was related to the average intake opportunity time. From these data it can be calculated that water applications at the bottom of the field averaged 84% of the application at the top end. Runoff rate was relatively constant and total runoff was only about half of that which would have occurred under fixed set surface irrigation. Variability of furrow infiltration rates was high, and 10% reduction in furrow supply rates would have resulted in water not reaching the ends of some furrows. In general the cablegation system provides more uniform water application than is normally achieved with other surface irrigation systems. The automatic cutback in supply reduces runoff, and the runoff is more easily reused because of its steady flow. (Baker-FRC)
W83-02437

IRRIGATION SCHEDULING PROCEDURE FOR SUBHUMID AREAS,
Missouri Univ.-Columbia. Dept. of Agricultural Engineering.
J. M. Gregory, and R. W. Schottman.
Transactions of the ASAE, Vol 25, No 5, p 1290-1294, September/October, 1982. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Irrigation practices, *Subhumid climates, Climates, Woodruff chart, Crop yields, Corn, Soybeans, *Missouri, *Irrigation scheduling.

A simple procedure for developing an irrigation scheduling chart has been developed for the subhumid climatic conditions typical of Missouri. The procedure is easily programmed on a computer for construction of individualized irrigation charts or tables. The Blaney-Criddle technique, one of many procedures for predicting consumptive use, was modified for the high humidity levels found in Missouri. Basic concepts of the Woodruff method which were retained include annual soil water recharge, excess rainfall in May and gradual depletion of soil moisture after June 1. The new method allows for variable planting data and crops other than corn. This method was developed for the claypan conditions in Missouri and should be checked if applied to other areas. (Baker-FRC)
W83-02438

SPRINKLER IRRIGATION UNIFORMITY REQUIREMENTS FOR THE ELIMINATION OF LEACHING,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
R. A. L. Brito, and L. S. Willardson.
Transactions of the ASAE, Vol 25, No 5, p 1258-1261, September/October, 1982. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Irrigation practices, *Water supply, *Leaching, *Sprinklers, Irrigation, Irrigation rates, Sprinkler irrigation, Zero leaching.

The objective of this study was to set guidelines for management of sprinkle irrigation for simultaneously maintaining crop growth and a condition of zero leaching. It was determined that zero leaching can be accomplished with a sprinkler system by reducing the average application amount to prevent any over-irrigation. The minimum required application is then controlled by the water requirement to keep the plants alive. The coefficient of uniformity is the adjustable parameter examined to obtain the required water application uniformity. When a zero leaching situation is desired and a minimum water application rate is required from a sprinkler system, an estimation of the minimum coefficient of uniformity (CU) necessary for the system can be obtained. Once the minumum water application ratio is decided upon, the given table then shows which minimum CU is recommended for the system and what upper and lower limits of water application should be observed to avoid unacceptable extremes. (Baker-FRC)
W83-02439

EMITTER PLUGGING AND DRIP IRRIGATION LATERAL LINE HYDRAULICS,
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
V. F. Bralts, I-P. Wu, and H. M. Gitlin.
Transactions of the ASAE, Vol 25, No 5, p 1274-1281, September/October, 1982. 9 Fig, 3 Tab, 16 Ref.

Descriptors: *Drip irrigation, Hydraulics, Irrigation, Irrigation practices, Fluid mechanics, Flow, *Lateral lines, *Emitter plugging.

The effects of emitter plugging on drip irrigation lateral line hydraulics were evaluated for both single-chamber and dual-chamber lateral lines. Theoretical equations were developed to show the relationship between the percentage of plugging and the percentage of total flow. Both the theoretical analysis and laboratory measurements were based on an assumption that the plugging position along a lateral line is uniformly distributed. The theoretical curves and laboratory measurements showed very close agreement. The relationship between the percentage of total flow and the percentage of plugging for single chamber lateral lines was very close to a direct proportion. The relationship between the percentage of total flow and the percentage of plugging for dual-chamber lateral lines was found to be dependent on the design ratio of inner to outer orifices. Theoretical curves were developed for predicting emitter plugging rates based on the change in lateral line flow. (Baker-FRC)
W83-02440

PROBLEM OF IRRIGATING RICE FIELDS,

All-Union Scientific Research Inst. of Rice (USSR).
V. B. Zaitsev.
Water Resources, Vol 9, No 1, p 44-52, January-February, 1982. 3 Fig, 5 Tab, 10 Ref. Translated from Vodnye Resursy, No 1, p 83-93, January-February, 1982.

Descriptors: *Rice, *Irrigation requirements, *Water use efficiency, Water conservation, Irrigation efficiency, Crop yield, *USSR, Seepage control, Water reuse, Pesticides.

Water duties for rice crops in Russia vary by 15,000-20,000 cu m per ha in different regions and within regions. Climatic conditions should account for only 2000 cu m per ha of this difference. Other factors having influences on water duties are hydrogeological conditions, design and quality of the system, and the efficiency of operation. River irrigation in the Petrovka-Anastasievka systems was studied from 1955, the second year of operation, to 1979. The duty decreased from 32.600 cu m per ha in 1955 to 17,300 cu m per ha in 1960 and remained at 16,100-16,700 cu m per ha until the end of the study. Rice yields (centners per ha) were 10.0 in 1955, 21.4 in 1960, and 33.3-46.2 until the end of the study. The decrease in duty and increase in yield were attributed to decreases in the zone of aeration, decreases in seepage from paddies and canals, reworking and compacting of soil with time, and increase in skills of persons operating the system. Systems in the same Krasnodar Territory had different average water duties and yields for 1971-75: Kuban, 18,800 cu m per ha duty and 50.5 centners per ha rice; Afipskii, 12,300 cu m per ha duty and 46.9 centners per ha rice. These differences are caused by variations in elevation, seepage losses, and soil and groundwater regimes. After stabilization of duties, further reductions can be attained by reusing waste waters, further improvement in operators' skills, elimination of large terracing, seepage control, elimination of nonproductive discharges of irrigation water, use of soil herbicides, and use of evaporation depressors. These measures should be applied first to regions with the highest duties. For some locations, improvement of existing systems will not be economical. The minimum duty calculated for the 45-47 degree North region in the USSR is 13,000 cu m per ha, slightly greater for the more southern regions. (Cassar-FRC)
W83-02447

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

PRELIMINARY DESIGN ON THE MUSKEG DRAINAGE SYSTEM AT ONAKAWANA, ONTARIO,
Calgary Univ. (Alberta). Dept. of Civil Engineering.
I. Muzik.
Canadian Journal of Civil Engineering, Vol 9, No 3, p 367-377, 1982. 12 Fig, 3 Tab, 16 Ref.

Descriptors: *Drainage systems, *Muskeg, Bogs, Wetlands, Drainage, Watersheds, Snowmelt, Rainfall, Runoff, Surface runoff, Estimating, Model studies, Kinematic waves, Waves, Kinematic wave theory, Mathematical studies, *Ontario.

A hydrologic study was undertaken for the planning and sizing of drainage structures in connection with a proposed coal mine at Onakawana in northeastern Ontario. The proposed mine site is blanketed by a layer of muskeg with an average thickness of 1.5 m. Dewatering of the muskeg is needed to facilitate mining procedures. Muskeg drainage systems must also efficiently handle surface runoff due to rainfall and snowmelt. A hydrological analysis of the muskeg and a hydrologic design for its drainage system are presented. Surface runoff quanitities were estimated by means of the rational method and a kinematic wave model of overland flow. A modified Glover-Dumm equation was used to calculate the ditch spacing required for dewatering. A simplified kinematic wave model of overland flow and the rational method have been found to be the most suitable methods for estimating design peak flow rates from small areas. (Baker-FRC)
W83-02101

EVALUATION OF DROUGHT POTENTIALS AND DAMAGES IN THE NORTHEASTERN UNITED STATES,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W83-02141

OPTIMAL REAL-TIME RESERVOIR SYSTEMS OPERATION: INNOVATIVE OBJECTIVES AND IMPLEMENTATION PROBLEMS,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
E. K. Can, M. H. Houck, and G. H. Toebes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173336, Price codes: A07 in paper copy, A01 in microfiche. Technical Report Number 150, November 1982. 137 p, 19 Fig, 22 Tab, 53 Ref. OWRT B-125-IND(1), 14-34-0001-1223.

Descriptors: *Reservoir operation, *Optimization, Objective function, Flood routing, Streamflow forecasting, *Kentucky, Four reservoir system, Model studies, *Real-time operation, *Goal programming, Green River Basin System, Nonlinearity.

This study deals with the optimization of real-time operations of reservoir systems and the associated implementation problems of these optimization models. A new method for determining optimal real-time operations of reservoir systems using preemptive goal programming is proposed and applied to a four reservoir system in Kentucky. Three methods are presented to handle the nonlinearity due to the maximization of hydropower. All three methods are approximations to a nonlinear optimization problem. The existence of some of the implementation problems of real-time reservoir operations models is demonstrated by examples. The problems that are studied are the effects of using approximate reach routing models, imperfect streamflow forecasts and incorrect objective functions in real-time operations of reservoir systems.
W83-02142

DYNAMIC PROGRAMMING APPLICATIONS IN WATER RESOURCES,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
For primary bibliographic entry see Field 6A.
W83-02147

CALCULATION OF MAXIMUM SPRING FLOOD DISCHARGES IN THE OKA BASIN,
Gidrometerologicheskii Inst., Odessa (USSR).
E. D. Gopchenko, and T. A. Simonova.
Water Resources (English Translation), Vol 8, No 6, p 591-597, November-December, 1981. 4 Fig, 1 Tab, 6 Ref. Translated from Vodnye Resursy, No 6, p 54-61, November, 1981.

Descriptors: *Flood discharge, *Mathematical equations, *Model studies, River basins, Oka basin, Seasonal variation, Hydrographs, Floods, Flood flow, *USSR.

Among the formulas used for calculating the maximum discharges of the spring flood, of greatest practical interest are the volume formulas, based on a geometrical schematization of the shape of the flood hydrograph in the form of a triangle, two parabolas, or other figures. Unlike the reduction formulas which express the dependence of the rate of maximum runoff on the drainage area or concentration time, these volume formulas more completely take into account the factors involved and make it possible to reflect individual characteristics of the drainage basins in an explicit form. A study was made using data of observations of the maximum runoff of the spring flood in the Oka basin to calculate maximum spring flood discharges. (Baker-FRC)
W83-02237

METHOD OF CALCULATING A COMPLEX OF WATER CONSERVATION MEASURES IN THE CASE OF INTERBASIN WATER TRANSFER,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Moscow (USSR).
For primary bibliographic entry see Field 5G.
W83-02240

APPROXIMATE ANALYTIC SOLUTION OF THE TRANSIENT FREE-SURFACE FLOW PROBLEM,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
M. G. Khublaryan, and O. O. Yushmanova.
Water Resources (English Translation), Vol 9, No 1, p 64-69, January/February, 1982. 4 Fig, 7 Ref. Translated from Vodnye Resursy, No 1, p 107-112, January/February, 1982.

Descriptors: Mathematical equations, *Model studies, Hydrodynamics, Flow, Environmental effects, Water management, Seepage, Irrigation, Reservoirs, Canals, Water table, *Surface flow.

An approximate method of solving the boundary-value problem when a free boundary is presented. An estimate is given of its accuracy by comparing the results of the approximate analytic solution with the numerical solution. When modeling water management systems and predicting their effect on the environment a quite important role is played by the choice of the mathematical model reflecting a particular physical process. This is particularly important when studying seepage from irrigated lands, reservoirs, and canals and when investigating their effect on the water table. (Baker-FRC)
W83-02253

DETERMINATION OF SEEPAGE LOSSES FROM THE NORTH CRIMEAN CANAL,
Ukrainskii Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Kiev (USSR).
R. A. Belenko, I. I. Il'in, Yu. A. Mikhailov, and I. S. Shpak.
Water Resources (English Translation), Vol 9, No 1, p 70-75, January/February, 1982. 3 Fig, 2 Tab, 13 Ref. Translated from Vodyne Resursy, No 1, p 113-119, January-February, 1982.

Descriptors: *Water loss, *Canals, *Water-balance method, Irrigation, Hydrodynamics, Model studies, Runoff, Drawdown, Infiltration, Groundwater recharge, Groundwater, *Seepage, North Crimean Canal, Seasonal variation, *USSR.

To determine water losses from canals it is proposed to use the method of water balance of canal stretches during short time intervals. This proposal formed the basis of a 5-year study of water losses from irrigation canals of the Crimea and from the main North Crimean canal. The essence of the proposed method consists in the continuous observation for 8-10 hrs of the income of water in the investigated stretch of the canal and runoff, its discharge by withdrawal along the length of the stretch, and change in the water level in the canal. The specific seepage from the North Crimean Canal, established by this method of the balance of the near-canal groundwater mound, varied during the irrigation season from 8 to 40 liters/sec-km. (Baker-FRC)
W83-02255

CHEMICAL AND MICROBIOLOGICAL COMPOSITION OF DRAINAGE WATERS IN FLOODPLAIN SOILS BEING DRAINED,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Tomsk (USSR).
For primary bibliographic entry see Field 5B.
W83-02256

COMPARISON OF CENTRAL ASIAN CANALS AND THE SOUTHERN PART OF THE DIVERSION ROUTE OF SIBERIAN WATERS,
Akademiya Nauk SSSR, Moscow. Geologicheskii Inst.
M. K. Grave, I. A. Klyukanova, V. P. Kostyuchenko, L. M. Grave, and E. N. Minaeva.
Water Resources (English Translation), Vol 9, No 1, p 60-64, January/February, 1982. 1 Tab, 5 Ref. Translated from Vodnye Resursy, No 1, p 102-105, January/February, 1982.

Descriptors: *Canals, *Design criteria, *Construction, Water conveyance, Water distribution, Waterways, Channels, Siberia, *USSR.

Characteristics of existing large central Asian canals for comparison with works planned for diverting part of the runoff of Siberian rivers to Kazakhstan and Central Asia. These canals can be divided into two groups. Members of the first group have a reliable watertight lining or are constructed in poorly permeable rocks. These canals are economical, their regime is more controllable and their effect on the environment is limited to the irrigation sphere. Canals belonging to the second group do not have a watertight lining and are constructed in readily permeable rocks. Functioning of such canals is accompanied by an intense effect on all natural components; this effect causes both positive and negative consequences that cannot always be foreseen when planning. On comparing the existing canals with the southern part of the Main Diversion Canal (MDC) many features of similarity with respect to lithologic and geomorphologic conditions and also with respect to possible consequences of its effect on the environment are revealed. Differences are also noted which are related to the characteristics of the climate, soil cover, development of biota, and other physiographic factors. The experience of building the existing canals shows that correcting their beds when crossing sand areas gives unquestionable advantages, such as reducing water losses and providing stability of the channel. (Baker-FRC)
W83-02257

A NOTE OF CHANGES IN CHANNEL GEOMETRY AT TRIBUTARY JUNCTIONS,
Hull Univ. (England). Dept. of Geography.
K. S. Richards.
Water Resources Research, Vol 16, No 1, p 241-244, February, 1980. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Channel morphology, *Tributaries, *Hydraulic geometry, Alluvial channels, Drainage networks.

Evidence is presented to justify the assumption that channel width varies stochastically about an approximately constant mean width within a stream link of an alluvial channel. Adjustments of channel width occur predominantly at junctions, but Miller's (1958) simple model describing such changes is misleading, and an alternative is proposed whose implication is that channel width (and probably other channel dimensions) is a power function of link magnitude. It is suggested that an alternative to conventional hydraulic geometry is provided by the combination of a step function describing changes at junctions and a stochastic model of variation within individual links. (Author's abstract)
W83-02288

MICROBIOLOGICAL CONTROL OF THE AQUATIC WEED, MYRIOPHYLLUM SPP,
Massachusetts Univ., Amherst. Dept. of Environmental Sciences.
H. B. Gunner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181958, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 129, Massachusetts University, Amherst, June 1982. 27 p, 11 Tab, 25 Ref. OWRT B-066-MASS(2), 14-34-001-9076.

Descriptors: *Aquatic weed control, *Myriophyllum, Aquatic plants, Aquatic bacteria, Aquatic fungi, Cyanophyta, *Biocontrol, *Cyanobacteria, *Decomposition, Water pollution control.

Bacteria, fungi and blue-green algae normally associated with the phyllosphere of Myriophyllum heterophyllum and Myriophyllum spicatum are among the principal decomposers of senescent plants. Stripped of this flora by various sterilizing techniques, the Myriophyllum extended its life by one third. The saprophytic process of decomposition was accelerated to pathogenesis by selecting from the community of microbial decomposers isolates which, when cultured on the appropriate cellulose and pectin media, could be induced to produce enzymes lytic to these tissues and ultimately lethal to the plant. That these are particularly vulnerable target tissues was confirmed by the induction of an extensive cellulolytic and pectinolytic microflora simply by the respective addition of sterile cellulose and pectin media in the test chambers which gave a significant increase in necrosis over untreated controls. In keeping with ecosystem specificity, there was a significantly higher pathogenic potential of the isolates from M. spicatum to that species than to M. heterophyllum. The results suggest that microorganisms native to the Myriophyllum ecosystem, selected for specific plant tissue attack, offer a promising avenue for the biological control of these aquatic nuisance plants.
W83-02321

RESPONSE OF HYDRILLA TO SELECTED DYES,
University of South Florida, Tampa. Dept. of Chemistry.
J. Barltrop, B. B. Martin, and D. F. Martin.
Journal of Environmental Science and Health, Part A, Vol 17, No 5, p 725-735, 1982. 1 Tab, 17 Ref.

Descriptors: *Weed control, *Hydrilla, *Dyes, *Aquatic weed control, Growth, Inhibition, Submerged plants, Herbicides, Methylene blue, Hematoporphyrin, Eosin Y, Plant growth.

The dyes methylene blue, hematoporphyrin, and Eosin Y inhibited growth of hydrilla by about 30% at initial dye concentrations of 0.0001 M dye. Hematoporphyrin was most effective, based on the weight required to reduce growth. Methylene blue was adsorbed onto the plant, but the other two dyes were not adsorbed. A mechanism for growth inhibition was proposed: that the dyes intervene in photodynamics. That is, the dye generates large numbers of singlet oxygen molecules, which destroy carotenoids and other cellular quenchers. (Cassar-FRC)
W83-02336

ANNUAL AND MONTHLY RESERVOIR OPERATING RULES GENERATED BY DETERMINISTIC OPTIMIZATION,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
M. Karamouz, and M. H. Houck.
Water Resources Research, Vol 18, No 5, p 1337-1344, October, 1982. 2 Fig, 7 Tab, 6 Ref.

Descriptors: *Reservoir operation, *Operating policies, *Streamflow, Reservoir releases, Water management, Optimization, *Algorithms, Benefits, Planning.

General reservoir system operating rules were developed by deterministic optimization. An algorithm which cycles through a deterministic dynamic program, a regression analysis, and a simulation model was described and tested for 48 cases. These included small to very large reservoirs, different streamflow characteristics, and annual or monthly time steps. Annual operating rules were determined for 12 cases (4 capacities at each of 3 single reservoir sites) and monthly operating rules for 36 cases (the same 4 capacities and 3 sites with different portions of the historical monthly streamflow records). At each iteration in the algorithm the reservoir releases became more constrained, refining the general operating rule. Data indicated that the first rule obtained was not the best rule in any case. Average loss reduction was 29.3%. Reservoir capacities of 20%, 50%, and 100% of mean annual flow reduced losses by 2.9%, 16.4%, and 39.5%, respectively. For 9 cases in which reservoir capacity exceeded mean annual flows, the average loss reduction obtained by refining operating rules was 58.5%. Selection of streamflow record sequence was also significant. Best results for different reservoirs were obtained from using different 15-year sequences. (Cassar-FRC)
W83-02344

REAL-TIME DAILY RESERVOIR OPERATION BY MATHEMATICAL PROGRAMMING,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
M. H. Houck.
Water Resources Research, Vol 18, No 5, p 1345-1351, October, 1982. 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Cost-benefit analysis, *Reservoir operation, Model studies, Mathematical models, Streamflow, Reservoir storage, Planning, Objective function.

Mathematical programming models for real-time reservoir operation were evaluated, using two measures of quality: total value of actual penalties incurred by the operation and the closeness of model results to theoretical best results. Of the five models, each with different types of objectives, two were superior. One of these (Model B) requires trial and error fitting of a 6-parameter objective function. The other (Model C) has an objective function which is completely defined and needs no parameter fitting. Model C is useful where only a reference set of historical operations is known. It can also be used to predict a reservoir operation program for a new development (turbine, dam, recreation) for which no experience has been accumulated. This eliminates the costly, sometimes unreliable cost-benefit procedure. (Cassar-FRC)
W83-02356

UNIFORM FLOW OVER SKEW SIDE-WEIR,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
S. C. Jain, and E. E. Fischer.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p 163-166, June, 1982. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Design criteria, *Drainage systems, *Mathematical studies, *Channel morphology, *Weirs, Irrigation ditches, *Mathematical models, Drainage engineering, Discharge measurement, Mathematical equations, Channels, Model studies, Theoretical analysis.

Side-weirs have been used extensively for diverting excess water from irrigation and drainage systems. A uniform discharge distribution over the side-weir can be obtained by a proper reduction in the width of the channel. A numerical solution was devised for the design of a side-weir with its crest oblique to the approach flow (skew side-weir) which would ensure an almost uniform discharge distribution from a rectangular channel over the skew side-weir. The theoretical results were verified in two experimental rectangular channels made from wood. Uniform discharge distributions over the side-weirs of both channels constructed in accordance with specified dimensions indicated good agreement with experimental and theoretical data. (Geiger-FRC)
W83-02400

THE USE OF A DISTRIBUTED CATCHMENT MODEL FOR THE EVALUATION OF DESIGN DISCHARGES IN THE URBAN ENVIRONMENT OF THE RIVER TAME, WEST MIDLANDS,
Severn-Trent Water Authority, Birmingham (England).
R. Wilkinson, and C. M. Simpson.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 4, p 309-317, 1982. 5 Fig, 4 Ref.

Descriptors: *Hydrologic models, *Flood control, *Urban watersheds, Rainfall-runoff relationships,

Model studies, Urbanrunoff, Runoff, Design floods, Tame River, Flood Studies Report, Hydrographs, River flow, Channel storage, Channel flow, *England.

The lumped model approach given in the United Kingdom's Flood Studies Report (FSR) was compared with a distributed model based on the Hydraulic Research Station FLOUT routing procedure in design of the Upper and Middle Tame River Flood Alleviation Scheme. The FSR model was inappropriate for use in the large catchment where Channel translation processes were significant. It did not reflect the changes produced by simulating changes in channel restrictions, which were proposed as part of the flood alleviation scheme. The synthetic hydrograph peak was earlier and lower and the falling limb showed less runoff than the observed peak because of channel storage upstream. The distributed model clearly showed the effects of removing restrictions for a 100-year flood in the Lea Marston catchment. (Cassar-FRC)
W83-02401

TRAFFICABILITY FACTOR IN A SILTY CLAY LOAM SOIL,
Maine Univ. at Orono. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W83-02421

4B. Groundwater Management

ARTIFICIAL RECHARGE OF SURFACE RUNOFF IN COLD SPRING VALLEY, NEVADA,
Nevada Univ. System, Reno. Desert Research Inst.
J. E. Dowden, M. E. Campana, S. W. Wheatcraft, and R. L. Jacobson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173229, Price codes: A04 in paper copy, A01 in microfiche. Publication No 41071, 1982. 50 p, 7 Tab, 9 Fig, 28 Ref. OWRT B-109-NEV(1), 14-34-0001-9082.

Descriptors: Groundwater, *Artificial recharge, Water salvage, *Aquifer model, Computer models, *Finite element model, Groundwater movement, Water harvesting, Infiltration, Infection, *Nevada, Cold Spring Valley, Runoff, Model studies.

Cold Spring Valley, Nevada was examined with the intent of developing a methodology for studying and implementing artificial recharge - surface runoff harvesting schemes that could be employed in other basins of Nevada. A steady-state, finite element model was used to simulate the Cold Spring Valley groundwater flow system. Calibration of the model along with limited field data suggests a hydrologic connection between Cold Spring and Upper Long Valley. Although the model only provides a steady-state approximation, the limited data base for most undeveloped areas in Nevada does not justify a more detailed analysis. For these areas, the model is considered suitable for similar applications. The primary limiting factor to any artificial recharge scenario in Cold Spring Valley is the response of the water table in the Reno Park subdivision caused by an increase in the septic field load. The existing groundwater and waste management practices mitigate against the implementation of artificial recharge in the valley at this time. In addition, difficulties are posed by the location of the optimum recharge site vis-a-vis the major surface runoff-producing area. However, with increasing growth in the valley, artificial recharge will undoubtedly become viable in the future.
W83-02131

CONJUNCTIVE MULTIBASIN MANAGEMENT: AN OPTIMAL CONTROL APPROACH,
California Univ., Davis. Dept. of Agricultural Economics.
J. E. Noel, and R. E. Howitt.
Water Resources Research, Vol 18, No 4, p 753-763, August, 1982. 3 Fig, 4 Tab, 26 Ref.

Descriptors: *Groundwater management, *Water supply, Management, *Irrigation, Model studies, *Economic factors, Interbasin transfers, Water transfer, *California, Yolo County district.

The economic effects of conjunctive management of ground and surface water supplies for irrigation are formulated as an optimal control model. An empirical hydroeconomic model is estimated for the Yolo County district in California. Two alternative solution methodologies (analytic Riccatti and mathematical programming) are applied and compared. Results indicate the economic potential for interbasin transfers and the impact of increased electricity prices on optimal groundwater management. The technique as presented has two important advantages over previous work done on optimal conjunctive water supply allocation. First, there is a direct interaction in the model between a complex hydrologic system and the demand for water. Second, the control model can be solved by several algorithms, two of which are demonstrated. (Baker-FRC)
W83-02162

DEWATERING OF AMBROSIA LAKE MINES,
Gulf Mineral Resources, Denver, CO.
H. C. Juvkam-Wold.
Mining Engineering, Vol 34, No 9, p 1344-1350, 1982. 7 Fig, 4 Ref.

Descriptors: *Aquifers, *Depressurization, *Wells, *Mines, *Dewatering, Aquifer characteristics, Water pressure, Grout curtain, Ambrosia Lake, *New Mexico.

The design of an aquifer depressurization system using wells is described. This particular system uses a number of wells surrounding a mine shaft to reduce the aquifer pressure in the vicinity of the shaft. The effect of various parameters such as number of wells, wellbore diameter, time, and well location is discussed. It is concluded that, with a properly designed depressurization system, the aquifer pressure and the water inflow rate to the shaft may be reduced to less than 15% of their potential values in the absence of wells. (Baker-FRC)
W83-02202

ESTIMATION OF GROUNDWATER RESOURCES ON THE BASIS OF DECISION-MAKING THEORY,
Akademiya Nauk Moldavskoi SSR, Kishinev. Inst. of Geophysics and Geology.
I. V. Zelenin, and V. I. Shumila.
Water Resources (English Translation), Vol 8, No 6, p 646-651, November/December, 1981. 3 Tab, 13 Ref. Translated from Vodnye Resursy, No 6, p 134-140, November/December, 1981.

Descriptors: *Groundwater resources development, *Estimating, *Decision making, Theoretical analysis, Hydrogeomechanics, Mathematical equations.

An approach is proposed to assess the hydrogeological situation and predict its change corresponding most appropriately to the decision-making problem under conditions of considerable uncertainty of hydrogeological constructions and ever-increasing price of losses associated with prediction errors. Such a formation as is presented here is more realistic and economically more effective than the presently adopted deterministic representation of hydrogeological information. It is also constructive from the viewpoint of substantiating the types and extent of hydrogeological investigations for solving particular engineering problems. (Baker-FRC)
W83-02252

CONSERVATION IN LONG TERM CONJUNCTIVE USE: IRRIGATION DEMANDS USING DISAGGREGATE CHOICE MODELS,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
B. C. Arntzen, D. H. Marks, J. L. Wilson, and R. Kryzystofowicz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181792, Price codes: A15 in paper copy, A01 in microfiche. Final Report (in three sections), March 30, 1981. 324 p, 23 Fig, 18 Tab, 107 Ref, 4 Append. OWRT C-90119-C(No 9430)(1), 14-34-001-9430.

Descriptors: *Conjunctive use, *Irrigation water, *Model studies, *Economic aspects, *Water management, Water demand, Groundwater irrigation, Surface water, Policy making, Water table rise, Water resources development.

Because surface water and groundwater possess different temporal, spatial, and legal characteristics, it is often desirable to exploit these differences to improve water supply system performance. This report presents the hierarchy of sub-problems involved in modeling the demand for conjunctive use. An historical description of the development of conjunctive user irrigation and a review of current policy initiatives of local water management institutions support the contention that the prime determinants of the demand for new conjunctive use systems for irrigation are their profitability and local water policies. It appears doubtful that farmers actively seek new sources of water in order to exploit the different characteristics of the sources to optimize their efficiency. Surface water is often not available to present groundwater irrigators because of their distance from surface supplies and because most western streams have been fully appropriated for many years. The demand for new groundwater capacity by surface water irrigators has two very different causes: use of groundwater to lower a rising water table; and use of groundwater because surface water is scarce and unreliable. The possible future implementation of comprehensive water management policies needs to be explored by examining the institutional objectives of local water management agencies, and developing a predictive model of the acceptance of conjunctive use policies by irrigators. (Moore-SRC)
W83-02320

STOCHASTIC ESTIMATION OF STATES IN UNCONFINED AQUIFERS SUBJECT TO ARTIFICIAL RECHARGE,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
K. D. Schmidtke, E. A. McBean, and J. F. Sykes.
Water Resources Research, Vol 18, No 5, p 1519-1530, October, 1982. 8 Fig, 1 Tab, 19 Ref.

Descriptors: *Stochastic process, *Artifical recharge, *Unconfined aquifers, Aquifers, Estimating, Mathematical studies, Recharge, *Ontario.

An extended Kalman filter model for characterizing minimum variance estimates of the piezometric heads and coefficients defining an unconfined aquifer subject to artificial recharge is developed. The system evolution model employs Hantush's characterization. Sensitivity analyses were used to test the estimation capability of the technique. The ability of the extended Kalman filter to use all available information from both the system model and measurements of the state to provide approximate minimum variance estimates of the state and confidence limits is shown. The extended Kalman fitler version of Hantush's model is applied to a record data length of one year obtained at the study area located in Norwood, Ontario. The results of the study indicate that the meteorological conditions influence the water table elevations to a greater extent than the particular rate of recharge employed. Observation of the measured values indicates that greater recharge rates could be employed during the summer months, when rainfall is low and evapotranspiration is high, and lower recharge rates during the winter months to prevent the water table from inundating the weeping tiles. (Baker-FRC)
W83-02351

ADAPTIVE EXPLICIT-IMPLICIT QUASI THREE-DIMENSIONAL FINITE ELEMENT MODEL OF FLOW AND SUBSIDENCE IN MULTIAQUIFER SYSTEMS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 2F.
W83-02352

AN INVESTIGATION OF THERMAL IMPACTS ON A SHALLOW AQUIFER FROM RECHARGE OF A GROUNDWATER HEAT PUMP SYSTEM,
North Dakota Univ., Grand Forks. Engineering Experiment Station.
D. W. Majkrzak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182063, Price codes: A04 in paper copy, A01 in michrofiche. North Dakota Water Resources Research Institute Completion Report, ND State Univ., Fargo, January 1982. 54 p, 43 Fig, 1 Append. OWRT A-069-NDAK(1), 14-34-0001-0136.

Descriptors: *Thermal pollution, *Groundwater, *Recharge, *Heat pump, Temperature, Reinjection, Thermocline, Thermal power, Heated water, Heat exchanger, Geothermal study, Seasonal, *Thermal gradients.

The site for monitoring thermal gradients experienced around the recharge well of a residential groundwater heat pump is located at Northwood, North Dakota (Figure 1). Ten test wells were drilled, surrounding the reinjection points, to monitor thermal gradients experienced in the vicinity of the recharge. Temperatures were recorded at 20 and 25 foot depths, corresponding to the top and bottom of the active section of the recharge casing with data collected every two weeks, beginning in November 1980 and continuing through December 1981. Well temperatures were also confirmed, using a thermocouple attached to a long probe. Examination of the test results indicated during heating that the discharge water had saturated the test area at a constant water temperature. The transition from heating to cooling was apparent in the data collected during the month of June and back to partial heating in October. Accurate thermal maps were developed during these periods. During the month of December 1981, two new test wells were installed at the site, which were evenly spaced toward the supply well. This site will be maintained and data collection continued through the 1982 calendar year at the University of North Dakota's own expense.
W83-02364

INVESTIGATION OF COUPLED SIMULATION METHODS FOR NORTH DAKOTA SPACE HEATING-COOLING SCENARIOS USING GROUNDWATER,
North Dakota State Univ., Fargo. Dept. of Mechanical Engineering.
H. R. Busby, and W. G. Rieder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182071, Price codes: A07 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute, Fargo, Completion report, August, 1982. 32 p, 2 Fig, 1 Tab, 46 Ref, 2 Append. OWRT A-071-NDAK(1), 14-34-0001-1136.

Descriptors: Aquifer, Heat transfer, Heat exchanger, *Simulation, *Aquifer management, *North Dakota, Groundwater, Algorithms, *Codes.

An investigation of thermal-reservoir simulation methods was aimed at finding a package which would be locally appropriate for shallow aquifers and coupled above-grade space heating-cooling systems. A combination of information solicitations, algorithm tests, literature surveys, and existing code reviews showed that most available codes were overly sophisticated relative to the original constraints established for local use. Available codes also tended to have common shortcomings in treating temperature-dispersion, thermal property-uncertainty, and buoyancy effects. As a consequence several small, streamlined, simulator codes were set up by using composites of existing programs; and validation tests were started. Both finite element and finite difference (Marker cell) methodologies were incorporated. From these the one having fewest limitations, a two-dimensional (pseudo three dimensional) marker-cell simulator, is presented along with a description of use limitations.
W83-02365

USE OF PROTOTYPE MODELING FOR ESTIMATING NATURAL GROUNDWATER RESOURCES,
Akademiya Nauk URSR, Kiev. Inst. Geologichnykh Nauk.
For primary bibliographic entry see Field 2F.
W83-02418

GROUNDWATER REGIME IN ZONES OF OPERATING ARTIFICIAL RECHARGE SYSTEMS,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
A. S. Chernov.
Water Resources (English Translation), Vol 8, No 6, p 637-642, November/December, 1981. 3 Fig, 2 Ref. Translated from Vodnye Resursy, No 6, p 120-128, November/December, 1981.

Descriptors: *Groundwater management, *Aquifer recharge, Artificial recharge, *USSR, Water supply, Water resources development, Infiltration, River basins, Caucasus.

Artificial groundwater recharge has been carried out by means of infiltration basin in the Caucasus since 1958. Regime observations were organized in 1977 to study the natural groundwater regime groundwater and its transformation in the area of the intake works under the effect of artificial recharge and long operation of the intake, to analyze the regime of surface waters, to refine the adopted technological scheme of artificial groundwater recharge, to refine the optimal operating regime of the infiltration works, and to analyze the experience of artificial formation of groundwaters under conditions of mountain-type river valleys. The study identified two types of groundwater regimes - natural and disturbed. The main factor forming the natural regime of near-channel groundwaters is the river hydrology. The disturbed regime is mostly affected by operation of the intake and artificial infiltration from the basins. Meteorological factors of precipitation and evaporation play only a secondary role except during basin cleaning. An important characteristic of the regime of groundwater level in the zone studied is its highly dynamic character and the considerable range of variations on comparatively small areas near the basins and river. It is advisable to regenerate the infiltration basins twice a year in the fall and spring, when the necessary capacity of the intakes can be provided due to seepage from the river without artificial recharge. The mineral content of the groundwaters was slightly higher than that of surface waters and was mostly in the form of calcium carbonate. Deterioration of the physical-chemical and bacteriological properties of the groundwaters was not observed. (Baker-FRC)
W83-02446

4C. Effects On Water Of Man's Non-Water Activities

FACTORS INVOLVED IN EVALUATING GROUND WATER IMPACTS OF DEEP COAL MINE DRAINAGE,
Geraghty and Miller, Inc., Champaign, IL.
P. R. Davis, and W. C. Walton.
Water Resources Bulletin, Vol 18, No 5, p 841-848, October, 1982. 11 Fig, 7 Tab, 6 Ref.

Descriptors: *Drawdown, *Coal mines, *Mine drainage, Permeability, Aquifers, Storage capacity, Model studies, Groundwater level, Wells, Transmissivity, Drainage, Pumping tests, Well data, *Indiana, Water quality.

Methods for evaluation of groundwater impacts of proposed deep coal mine drainage are illustrated, using the example of a proposed mine in southwestern Indiana. The coal seam considered for mining is the Indiana V seam, which lies in a thick sequence of sandstone, shale, limestone, and coal units. Data were obtained from three production wells in the area. Drawdowns in aquifers were determined by modeling a 5-year plan for mining as follows: Year 1, construct a 20 ft diameter mine shaft through sand and gravel; Year 2, advance shaft through bedrock to coal seam, Years 3-5, develop 600 ft wide mine drifts according to plan. Estimated drawdown after 5 years was: in bedrock, 400 ft in the immediate vicinity of the mine drifts to 1 ft at 1/2 mile away; in gravel and sand, 0.5 ft near the center of mine drifts to 0.25 ft at 100 ft distant. The increase in recharge and decrease in evapotranspiration would produce a very small net change in groundwater budget. Gathering data from production wells is often complicated by low permeabilities of rock in coal seam systems, low pumping rates, limited cones of depression, long required pumping periods, and the effects of well storage capacity. Simulation of coal mine drainage involves horizontal permeabilities and storage coefficient of the coal seam zone, vertical permeabilities of the aquitard above and below the coal seam zone, and the hydrologic properties of the source bed above the aquitard overlying the coal seam zone. The groundwater level declines in coal seam zone and source bed near the land surface must also be considered in impact analysis. (Cassar-FRC)
W83-02149

EFFECTS OF URBANIZATION ON BASE FLOW OF SELECTED SOUTH-SHORE STREAMS, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
D. L. Simmons, and R. J. Reynolds.
Water Resources Bulletin, Vol 18, No 5, p 797-805, October, 1982. 5 Fig, 3 Tab, 18 Ref.

Descriptors: *Base flow, *Urbanization, *Sewer systems, Streamflow, Low flow, Long Island, *New York, Storm runoff, Storm sewers, Water table aquifers, Recharge, Groundwater recharge.

Hydrographs of six gaged streams on Long Island's south shore were analyzed to assess the effects of urbanization on streamflow. The mean base flow components of total annual streamflows, based on data from 1948 to 1970, were: urbanized sewered area in southwestern Nassau County, 45-61%; urbanized unsewered area in southeastern Nassau County, 86-88%; and a rural unsewered area, 96%. From 1948 to 1970 the base flow component remained constant in the rural streams; decreased from 95% to 20% (sometimes as low as zero in some years) in the urbanized sewered area; and decreased from 95% to about 84% in the urbanized unsewered area. Double mass curve analysis indicated that the changes in streamflow began in the early 1960's in the sewered area and in the late 1960's in the urbanized unsewered area. Causes of the reductions in base flow were discharge of treated effluents to tidewater, routing of storm runoff directly to streams through storm sewers, and decrease in precipitation infiltration because of decreased permeable area. (Cassar-FRC)
W83-02170

FOG DRIP IN THE BULL RUN MUNICIPAL WATERSHED, OREGON,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forestry Sciences Lab.
R. D. Harr.
Water Resources Bulletin, Vol 18, No 5, p 785-789, October, 1982. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Fog, *Precipitation, *Logging, Interception, Streamflow, Clear-cutting, Forest management, *Forest watersheds, Fox Creek, Bull Run Watershed, Portland, *Oregon, Vegetation effects, Trees, Rain gages, Gaging, Condensation, Soil-water-plant relationships, Watersheds, Douglas fir.

Net precipitation (gross precipitation plus fog drip minus interception loss) under old growth Douglas fir forest in the Bull Run Municipal watershed, Portland, Oregon, was 1739 mm during a 40 week snow-free period. This was 387 mm more than in adjacent clear-cut areas. Calculations determined

that fog drip could have added 882 mm of water during a year, based on 2160 mm of rain measured in a nearby clearing. Implication of these findings are: rain gages installed in open areas where fog is common may collect up to 30% less precipitation than in a forest, and timber harvesting may reduce annual water yield and summer streamflow. (Cassar-FRC)
W83-02173

EVALUATION OF THE REDUCTION OF THE VOLUME OF FLOW CARRIED BY CERTAIN RIVERS OF PUERTO RICO AND ITS POSSIBLE CORRELATION WITH CHANGES IN LAND USE, FROM 1508 TO PRESENT,
Puerto Rico Univ., Mayaguez. Dept. of General Engineering.
For primary bibliographic entry see Field 2E.
W83-02215

4D. Watershed Protection

IMPROVING WATERSHED-MODEL ACCURACY BY USING DIGITAL TOPOGRAPHY,
West Virginia Univ., Morgantown. Water Research Inst.
For primary bibliographic entry see Field 2A.
W83-02233

CALCULATION OF THE RUNOFF-REGULATING EFFECTIVENESS OF FOREST BELTS,
All-Union Scientific Research Inst. of Soil Erosion Control, Kursk (USSR).
A. Kh. Alibekov, and V. S. Burumenskii.
Water Resources (English Translation), Vol 8, No 6, p 597-603, November/December, 1981. 2 Fig, 5 Ref. Translated from Vodnye Resursy, No 4, p 62-69, November/December, 1981.

Descriptors: *Rainfall-runoff relationships, *Erosion control, *Forests, Mathematical equations, Absorption, Snowmelt, Runoff, Rainfall, Erosion.

In connection with the fact that water-regulating forest belts comprise one of the elements of a complex of erosion-control measures accomplished on slopes, an estimate of their runoff-regulating ability is needed first of all for calculating the residual runoff. A quantitative estimation of the effect of the age of the forest and location of the forest belts on the slope acquires considerable importance, along with the well-known factors determining the water absorbing ability of soils within the forest belt. In this case it is possible to estimate that part of the runoff which is absorbed by the forest belts from the slope. In one of the possible variants of the solution a formula is proposed which makes it possible with some degree of approximation to calculate the amount of reduction of the overland runoff under the effect of forest belts, but does not take into account such important indices as their age and location on the slope. This problem can be solved if the water absorption within the forest belt during the period of the spring or storm runoff is known. Such water regulating forest belts which can absorb both the water equivalent of snow and the runoff arriving from above are considered in the calculations presented in this paper. For these calculations it is assumed that the width of the forest belt is small compared to the distance between the watershed and the forest belts or only between the forest belts. Only the distances to the lower borders of the forest belts are introduced into the calculation scheme. (Baker-FRC)
W83-02238

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

THE APPLICATION OF A LASER INTRACAVITY ABSORPTION DETECTOR TO GAS CHROMATOGRAPHY OF TRACE ORGANIC POLLUTANTS IN WATER,
Arkansas Water Resources Research Center, Fayetteville.
R. B. Green.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173195, Price codes: A03 in paper copy, A01 in microfiche. Publication No 89, December 19282. 24 p, 3 Fig, 2 Tab. OWRT B-066-ARK(1), 14-34-0001-1205.

Descriptors: Organic wastes, *Lasers, *Gas chromatography, Trace levels, *Pollutant identification, *Water analysis, Analytical techniques, *Trace organics, Infrared, *Laser intracavity absorption detector.

A helium-neon (HeNe) laser operating simultaneously at 3.39 um (infrared) and 0.63 um (visible) has been used as a selective detector for hydrocarbons in the effluent of a gas chromatography. The infrared and visible laser transitions originate at the same energy level and are competitive. When a hydrocarbon enters the laser's resonant cavity, the 3.39 um is absorbed due to the C-H stretching vibration and the visible emission is enhanced. The visible laser emission is monitored with a photodiode as a quantitative measure of the concentration of the absorbing molecule. The minimum detectable concentration for propane using the double-beam configuration is 20 pg/mL, which is 25 times lower than the best value reported for a thermal conductivity detector. In practice, the detector's selectivity for hydrocarbons is modified by various substituents. The detector responds to aliphatic and aromatic hydrocarbons with aliphatic side chains, except for those substituted with halogens. The NeHe laser intracavity absorption detector may be used without prior separation in some cases (e.g., methane in coal mines). This detector operates with nitrogen carrier gas without sacrifice of sensitivity and should be useful for monitoring organic pollutants since it does not respond to water or carbon dioxide. Also, it should be possible to manufacture this detector at competitive prices.
W83-02128

TOTAL OXYGEN DEMAND--RECENT ADVANCES IN THE AUTOMATIC OXYGEN DEMAND ANALYSIS TECHNIQUE,
Ionics, Inc., Watertown, MA.
D. E. Lueck, R. A. Dishman, and R. B. Thayer.
ISA Transactions, Vol 20, No 2, p 67-76, 1981. 10 Fig, 2 Tab, 17 Ref.

Descriptors: *Oxygen demand, *Organic compounds, *Pollutant identification, *Total oxygen demand, Water analysis, *Biochemical oxygen demand, *Chemical oxygen demand, Organic carbon, Automation, Monitoring.

Total oxygen demand (TOD) analysis has proved faster, more accurate, and less subject to interferences than BOD and COD analyses. TOD more accurately reflects the oxygen demand impact of organic pollutants on receiving waters than total organic carbon determination. TOD is unaffected by inorganic carbon. It measures oxygen consumption and reflects the oxidation state of the organic carbon. TOD analysis also indicates noncarbonaceous materials that consume or contribute oxygen (ammonia, sulfite, sulfides). Interferences in TOD analysis are nitrate and acidic sulfate, which produce low readings, and dissolved oxygen at low-range measurements. The goals of recent improvements on the TOD method include operation below 50 ppm TOD, elimination of salt interferences, and solving of problems in combustion which produced poor results. The present models of equipment, Ionics Model 1248 laboratory TOD analyzer and Ionics Model 1270M Combination TOD/TOC analyzer, have solved previous problems and feature improved, automatic, reliable, high sensitivity determinations. (Cassar-FRC)
W83-02195

BIOLOGICAL INDICATION OF WATER QUALITY: THE GEOGRAPHIC ASPECT,
All-Union Scientific-Industrial Association of the Pulp and Paper Industry, Moscow (USSR).
V. A. Alekseev.
Water Resources (English Translation), Vol 9, No 1, p 92-98, January/February, 1982. 1 Tab, 7 Ref. Translated from Vodnye Resursy, No 1, p 140-146, January/February, 1982.

Descriptors: Water quality, *Bioindicators, *Monitoring, *Biomonitoring, *Insects, *USSR, Water quality control, Water pollution control, Pollutant identification.

A method for biomonitoring is proposed. This method is based on the bioassay, that is, on an acute, brief experiment, although it involves a more complex organization, stringent standardization, and unification with respect to many components. The comparative toxic substance resistance of a large group of aquatic macroinvertebrates-insects and arachnids - was investigated in 1970 at the facilities of the Institute of Biology of Inland Waters, Academy of Sciences of the USSR. Insects were represented by 46 species, mainly larvae of caddisflies, mayflies, stoneflies, beetles, dragonflies, dipterans, alderflies, butterflies, and also the imagoes of bugs and beetles. The results obtained made it possible to establish a distinct regularity of resistance of the investigated animals to the effect of the toxicant. At the same time the order of resistance of the organisms to phenol was not a reflection of the specific effect of the model toxicant alone, but was characteristic with respect to the effect of the majority of toxicants of the most diverse origin. The established regularity of resistance of hydrobionts to toxic action is the basis for creating a unified indicator system at the level of macroorganisms. However, composed of organisms of only one geographic zone, the system will be complete only on broadening comparative toxicological investigations conducted by a single unified method in various geographic regions of the country. (Baker-FRC)
W83-02236

GAS CHROMATOGRAPHIC ANALYSIS OF HALOCARBONS IN DRINKING WATER BY HEADSPACE EXTRACTION AND MIXED COLUMN SEPARATION,
Genoa Univ. (Italy). Inst. of Industrial Chemistry.
G. Castello, T. C. Gerbino, and S. Kanitz.
Journal of Chromatography, Vol 247, No 2, p 263-272, 1982. 3 Fig, 4 Tab, 35 Ref.

Descriptors: *Chlorinated hydrocarbons, *Water analysis, *Gas chromatography, *Trihalomethanes, Chlorination, *Pollutant identification, Drinking water, Organic compounds.

Trihalomethanes formed by chlorination during water treatment were completely resolved by gas chromatographic analysis using a series arrangement of polar and nonpolar liquid stationary phases. These were SP-100 (polar polyethylene glycol Carbowax 20M plus terephthalic acid) and OV-101 (nonpolar methylsilicone). Liquids were applied at 10% concentrations on 80-100 mesh Chromosorb W DMCS. A headspace extraction technique and a Ni63 electron-capture detector were used for quantitation. The compounds separated were those produced by chlorination of natural water (chloroform, dichlorobromomethane, dibromochloromethane, and bromoform) and common industrial solvents (1,1-dichloroethylene, methylene chloride, 1,1-dichloroethane, 1,1,1-trichloroethane, carbon tetrachloride, trichloroethylene, and tetrachloroethylene). Mixed columns (both phases on the same column) required complex preparation methods and had lower resolving powers. With proper temperature programming of the column, an analysis can be completed within 30 min. There are no interferences with the common extraction solvents, n-pentane, n-hexane, and isooctane. (Cassar-FRC)
W83-02284

ANALYSIS OF INORGANIC ANIONS IN THE POTOMAC WATER SEDIMENT AND FLOC BY ION CHROMATOGRAPHY,
American Univ., Washington, DC. Dept. of Chemistry.
J. E. Girad.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-180299,

Price codes: A03 in paper copy, A01 in microfiche. D. C. Water Resources Research Center Report No 37, Univ. of the District of Columbia, May 1982. 33 p, 4 Tab, 8 Ref, 12 Fig. OWRT A-011-DC(1), 14-34-0001-1109.

Descriptors: *Municipal water, *Sediment, *Floc, Electrical conductance, Polivalent anions, Ionic concentration, *Ion chromatography, Analytical chemistry, *Pollutant identification, Potomac River, District of Columbia.

Recent reports by the authors have shown non-suppressed ion chromatography, which uses conventional high pressure liquid chromatography (HPLC) instrumentation, to be a low cost analytical technique for the analysis of inorganic anions. A Varian Model 5000 HPLC was coupled with a Wescan Conductivity Dectector. All separations were achieved on a Vydac 302 IC Column at a controlled temperature of 30C. This system is designed to work without a suppressor column, thus achieving better chromatographic efficiency and saving time in regenerating the suppressor column. Very efficient separations of anions such as Cl super -, NO sub 3 super -, and SO sub 4 super -2 are easily achieved with this system. The sensitivity we have observed for Cl super - ions (0.5 PPM) is comparable to conventional supressed IC. Sensitivity for nitrate (1.25 PPM) and sulfate (1.25 PPM) is only slightly less than that which is observed for the conventional supressed IC method. Linearity is very good over a wide concentration range. By changing the eluting species, its concentration or the pH, improved sensitivity, chromatographic efficiency, selectivity and resolution may be achieved. This technique has been successfully applied to the analysis of municipal water samples from Howard, Baltimore and Montgomery Counties in Maryland, as well as the District of Columbia. Samples of Potomac River water taken at the Chesapeake Bay/Potomac River interface are usually very difficult to analyze, since there is a small amount (10-15 PPM) of Chloride ion. Potomac River samples were also successfully analyzed.
W83-02292

DETERMINATION OF NITRITE AND NITRATE IN WATER BY REDUCTION TO AMMONIA FOLLOWED BY ENZYMATIC CYCLING,
American Univ., Washington, DC. Dept. of Chemistry.
F. W. Carson, and P. L. Rogers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-180331, Price codes; A03 in paper copy, A01 in microfiche. D. C. Water Resources Research Center Report No 42, Univ. of the District of Columbia, September 1982. 28 p, 2 Fig, 2 Tab, 16 Ref. OWRT A-019-DC(1), 14-34-0001-2109.

Descriptors: *Nitrate, *Nitrite, *Ammonia, *Enzymatic cycling, *Assay, Analysis, Colorimetic, Amonium chloride, Absorbance linear regression analysis, Hydrochloric acid, Reduction, Spectorphotometry, Interferences, *Pollutant identification.

A procedure has been developed to determine the concentration of biologically significant nitrogen present as ammonia, nitrite and nitrate in water samples colorimetrically. In addition, the concentration of each of these constituents may be determined separately if desired. The method is sensitive and not subject to the interferences commonly encountered in nitrate determinations. It involves the reduction of nitrite and/or nitrate to ammonia with Devarda's metal while simultaneously trapping the released gaseous ammonia with dilute hydrochloric acid solution in a modified Conway diffusion cell. Subsequently, the ammonia is determined using the enzymatic cycling assay previously developed by Carson and Davies. Standard solutions of ammonium chloride must be carried through the procedure to prepare a standard curve from which unknown concentrations of nitrate may be determined. Using the established procedure, plots of Absorbance change at 600 nm versus original nitrate concentration wre linear, with correlation cofficients ranging from 0.991 to 0.999. A series of replicate measurements had a coefficient of variation of 3% for samples containing 2.70 x 10 super -5 M nitrate ion when compared to such a standard curve.
W83-02296

CHARACTERISTICS OF MUNICIPAL WASTEWATERS,
Southern California Coastal Water Research Project Authority, Long Beach.
H. A. Schafer.
In: Coastal Water Research Project, Biennial Report for the Years 1981-1982, Willard Bascom, ed. p 11-16, 1 Fig, 5 Tab.

Descriptors: *Pollutants, *Municial wastewater, *Suspended solids, *DDT, *Heavy metals, Effluents, Chlorinated hydrocarbons, Trace metals, Flow, arsenic, Cadmium, Chromium, Coper, Lead, Mercury, Nickel, Selenium, Silver, Zinc.

Municipal wastewaters account for most of the pollutants entering southern California's coastal waters. During 1980 and 1981 the flow from the largest ocean dischargers averaged 1,094 million gallons per day (4.1 billion liters/day) and contained 610 metric tons of suspended solids. Data are presented showing the average annual concentration and calculated mass emissions of some constituents from 1971-1981, and the trends of five constituents for the past 11 years. During the last two years, discharge trends relative to general constituents showed that the flow is 40 mgd higher than the previous high, with Orange County having over half the increase, that BOD5 is the highest since 1971, and that suspended solids are the lowest in 11 years. BOD is usually less than suspended solids but has been greater in the past four years, reflecting the importance of dissolved BOD, or the higher demand of the remaining suspended solids. Of ten metals measured, seven were at the lowest reported levels since reporting began. Arsenic and selenium, discharged in small amounts, show no consistent trend. Silver decreased in 1980 and 1981 after increasing during the past four years. Relative to chlorinated hydrocarbons, DDT continues to decrease 20-30% per year with total output being less than 500 kg. for the first time. PCBS have not dropped much since 1979 and remain about 1,200 kg. per year, although PCBs are distributed more evenly than DDT. (Atkins-Omniplan)
W83-02301

SEAWATER AND WASTEWATER TOXICITY STUDIES,
Southern California Coastal Water Research Project Authority, Long Beach.
P. S. Oshida, S. M. Bay, A. Haeckl, K. Goochey, and D. Greenstein.
In: Coastal Water Research Project, Biennial Report for the years 1981-1982, Willard Bascom, ed. p 39-44, 3 Fig, 5 Tab, 4 Ref.

Descriptors: *Municipal wastewater, *Wastewater disposal, *Toxicity, *Bioassay, *Water sampling, Ocean disposal, Echinoderms, Outfall, Morphology, Fertilization, Larvae, Effluents, Water treatment facilities.

To set meaningful discharge criteria for municipal wastewater disposal, a new bioassay based on echinochrome systhesis by larval sea urchins has been used. The goals of this project were to evaluate the bioassay's ability to detect toxicity in complex seawater and wastewater samples and to estimate the range of toxicity present in harbor and offshore areas. The bioassay was conducted with seawater from harbor and offshore stations, seawater from near an outfall and wastewater effluents from five treatment plants. Monthly samples of offshore and harbor waters were tested for toxicity using three bioassay methods: echinochrome production, 15-minute fertilization production, and 48-hour developmental morphology. Using these methods, the samples showed only sporadic toxicity over a 14-month period; the specific compounds causing the toxicity were not determined but could have been in response to natural toxins. The echinochrome and development tests appeared more sensitive to toxicity than the 15-minute test. After testing the three methods on different water samples, the echninochrome test was shown to be faster, simpler, more reliable, and therefore, the best bioassay for general use. This procedure requires only 25% of the time needed for the development test and requires less technical and biological expertise. The echinochrome bioassay is a convenient way of detecting toxicity and appears more sensitive than the other two methods. It is also sensitive to concentrations of about 1% which is about equal to the levels at the edge of each outfall's initial dilution zone, and thus, a useful indicator of possible toxicity outside the zone of dilution. (Atkins-Omniplan)
W83-02306

METALS IN SURFACE SEDIMENTS FROM POINT DUME TO POINT HUENEME,
Southern California Coastal Water Research Project Authority, Long Beach.
G. P. Hershelman, P. Szalay, and C. Ward.
In: Coastal Water Research Project, Biennial Report for the Years 1981-1982, Willard Bascom, ed. p 259-265, 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Trace metals, *Volatile solids, *Particle size, *Water depth, *Sediments, Outfalls, Sampling, Settling velocity, Sediment distribution, Correlation coefficients, Cadmium, Chromium, Copper, Lead, Nickel, Silver, Zinc.

During 1980, the Coastal Water Research Project added 73 stations to its survey of the coastal shelf and slope of southern California. Prior surveys off the Palos Verdes Peninsula and Santa Monica Bay found highly elevated metal concentrations in surface sediments. This report provides the measurements of seven trace metals and four physical parameters, such as water depth, total volatile solids, and percent solids, in a region where the Infaunal Index indicates normal conditions exist. Concentrations of silver, cadmium, chromium, copper nickel, lead and zinc are presented. Only a single measurement per station for each parameter was made, however, there was a high correlation of trace metal concentrations with the physical components of the sediments. In deeper water, the sediments are composed of smaller particles, therefore, trace metal concentrations increase with depth. Total volatile solids (TVS) also correlate positively with increasing water depth because of the adsorptive qualities of finer grain size. Therefore, trace metal concentrations also correlate with TVS, and some portion may be attached to the volatile solids. Percent solids yield high (negative) correlation coefficients with metals because low percent solids reflect more water content which occurs with fine grain size sediment. Lead yielded the lowest correlation coefficient with water depth. In general, trace metals fall within control values and correlate positively with water depth, TVS, and smaller particle size fractions of the sediments. There was a negative correlation between metals and the dry to wet weight ratio of the sediments. (Atkins-Omniplan)
W83-02309

USEFULNESS OF THE SELF-FERTILIZING CYPRINODONTID FISH, RIVULUS MARMORATUS AS AN EXPERIMENTAL ANIMAL IN STUDIES INVOLVING CARCINOGENESIS, TERATOGENESIS AND MUTAGENESIS,
Charleston Coll., SC. Grice Marine Biological Lab.
C. C. Koenig, D. C. Abel, C. W. Klingensmith, and M. B. Maddock.
Environmental Protection Agency Project Summary EPA-600/S3-82-075, September 1982. 5 p, 2 Fig, 3 Tab.

Descriptors: *Bioassay, Monitoring, Water quality, Toxicity, Fish behavior, *Carcinogens, *Mutagens, *Teratogens, Larvae, *Caribbean region, *Biomonitoring, *Pollutant identification.

Rivulus marmoratus is a naturally self-fertilizing cyprinodontid fish inhabiting mangrove throughout the Caribbean. As a result of internal self-fertilization, this oviparous species is composed of a number of isogenic, homozygous lines (clones), several of which have been identified by histocompatibility tests and maintained in laboratory culture

for over 30 years. Simplified culture and handling methods are given and data are presented on the reproduction, growth and development of rivulus under laboratory culture. Several types of bioassays were run and evaluated using rivulus; behavioral, carcinogenic, teratogenic, toxic, and mutagenic. Behaviorally, rivulus is capable of detecting and avoiding water contaminated with hydrogen sulfide. They respond by leaping from the water and remaining emergent for various periods of time while respiring cutaneously. Rivulus shows promise in water quality management as a test animal for biological monitoring. The behavior is easily quantified, the response is rapid, and normal variations in environmental parameters do not elicit the response. Hepatocellular carcinoma, among the pathological changes, was observed in livers of rivulus a year after exposure of adults and larvae to diethylnitrosamine. High rates of various skeletal malformations were found in offspring of adults exposed to dibutyl phtalate and 2,3,4,6,-tetrachlorophenol. Because of the many attributes of rivulus, including genetic uniformity of clones, it is anticipated that further development of this assay would produce a powerful tool useful in water quality management. (Moore-SRC)
W83-02313

DETECTION OF IODINE SPECIES IN DILUTE AQUEOUS SOLUTIONS AND THE MODIFICATION OF THE PHYSICAL AND CHEMICAL PROPERTIES OF IODIDE SALTS WITH MACROCYCLIC MULTIDENTATE LIGANDS,
Georgia Inst. of Tech., Atlanta. Dept. of Chemistry.
C. L. Liotta, R. C. McFarland, and M. B. Bruce.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182030, Price codes: A02 in paper copy, A01 in microfiche. Environmental Resources Center Report No ERC 11-82, November 1982. 23 p, 5 Tab, 17 Ref. OWRT A-074-GA(1), 14-34-0001-8011.

Descriptors: *Anion exchange, Anion exchange resins, *Aqueous solutions, Chromatography, Gas-liquid chromatography, Indicators, *Iodine species, *Iodocatechol, Macrocyclic multidentate, *Ligands, Mass spectrometry, Metal ion salts, Organo-iodine product, Organic molecules, Quantitative methods, Radiation degradation, *Solvent extractions, *Spectrometry, Starch indicators, *Pollutant identification.

Quantitative methods for the detection and determination of the following iodine species in dilute aqueous solution have been explored: I super -, I sub 2, I sub 3 super -, HOI, HIO sub 3 and HIO sub 4. Qualitative procedures for the detection of I sub 2 and I sub 3 (starch indicator method, organic solvent extraction method, and I sub 3 super - chromophore method) were employed to determine if reaction took place between the above iodine species (I super -, I sub 2, I sub 3 super -, HIO, HIO sub 3 and HIO sub 4) and a variety of organic molecules (phenols, glycols and related structures, amino acids, aromatic acids, aromatic chlorides) under dilute aqueous conditions. In a few cases (catechol and p-hydroxybenzoic acid) the organo-iodine product was synthesized by an alternate route and compared with the reaction sample by gas-liquid chromatography and mass spectrometry. Reaction of inorganic iodine with catechol was studied in the absence and presence of gamma radiation. Iodocatechol was identified as the product in the former case but no identifiable organic products were produced in the latter. The primary source or organic material in power reactor primary coolant systems is radiation degradation of the organic cation and anion exchange resins. The primary gaseous products identified from this decomposition are methane, ethane and propane. Complexes of metal ion salts of I sub 3 super -, I sub 2 Br super - and I super - with macrocyclic multidentate ligands were prepared. In addition, the reactivity of iodide ion in these complexes with a variety of alkylhalides was investigated in non-polar (benzene) and dysolar, aprotic (acetonitrile) solvents.
W83-02360

ANALYZING ASBESTOS FIBERS IN WATER BY MEANS OF TRANSMISSION ELECTRON MICROSCOPY,
Washington Univ., Seattle. School of Public Health and Community Medicine.
E. S. Boatman.
Journal of the American Water Works Association, Vol 74, No 10, p 533-536, October, 1982. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Asbestos, *Electron microscopy, *Pollutant identification, Drinking water, Water analysis, Fibers, Sample preparation, Turbidity, Water treatment.

A transmission electron microscopy method for determining asbestos fibers in drinking water is described in detail. This procedure requires special facilities, extensive manipulations, and excellent laboratory technique. Sample collection should include a history of the water source (meteorological conditions, presence of asbestos-cement pipe, etc.). Sample preparation and analysis should be done in an ultraclean room with a laminar flow biohazard cabinet, a highly efficient water still or filtration-ion exchange system, a suitable transmission electron microscope, vacuum evaporator, low temperature asher, and membrane filters. Procedures for sample filtration, counting, and identification are given. Asbestos fibers have parallel sides, a length to width ratio of > 3:1, and a distinctive morphology and crystalline structure. They may be classified as chrysotile, amphibole, ambiguous, or nonasbestiform. Fiber counts are recorded in millions of fibers per liter of water (MFL), knowing the average area for a filter grid square, the volume of water filtered and the fiber count. A suitable fiber distribution for accurate results is 5-100 fibers per 30 grid squares. In general, water flowing in asbestos-cement pipes has a large proportion of fibers with lengths > 1.0 microns, with a mean length of 4.5 microns and a maximum length of 80 microns. (Cassar-FRC)
W83-02382

COMPARISON OF SEVERAL INSTRUMENTAL METHODS FOR DETERMINING CHLORINE RESIDUALS IN DRINKING WATER,
Florida International Univ., Miami. Drinking Water Quality Research Center.
W. J. Cooper, M. F. Mehran, R. A. Slifker, D. A. Smith, and J. T. Villate.
Journal of the American Water Works Association, Vol 74, No 10, p 546-552, October, 1982. 12 Tab, 25 Ref.

Descriptors: *Chlorine, *Water analysis, *Residual chlorine, *Pollutant identification, Drinking water, Amperometric titration, Electrodes, Membrane electrodes, Statistical analysis, Potentiometric electrodes, *Measuring instruments, *Water treatment.

Four methods for determining chlorine residuals in water were evaluated: two membrane electrodes, a potentiometric electrode, and a continuous total chlorine analyzer. Amperometric titration was used as a referee method. Two types of water samples were analyzed, quality assurance samples from the U.S. EPA and tap water. Results of analysis by the four methods were compared statistically for the quality assurance samples and for total chlorine in tap water. The total chlorine analyzer produced the best precision for individual analysts. Precision of all analysts was best with the total chlorine analyzer, followed by the amperometric titration, then the potentiometric electrode. (Cassar-FRC)
W83-02383

A NOTE ON THE ISOLATION AND ENUMERATION OF GRAM POSITIVE COCCI FROM MARINE AND ESTUARINE WATERS,
Maryland Univ., Baltimore. Dept. of Microbiology.
B. A. Gunn, F. L. Singleton, E. R. Peele, and R. R. Colwell.
Journal of Applied Bacteriology, Vol 53, No 1, p 127-129, 1982. 2 Tab, 10 Ref.

Descriptors: *Bacteria, *Saline water, *Pollutant identification, Estuaries, Seawater, Staphylococcus, Micrococcus, Streptococcus, Heterotrophic bacteria, *Gram positive bacteria, *Cocci, Chesapeake Bay, Narragansett Bay, Atlantic Ocean, Puerto Rico Trench dump site, Data collections.

Gram positive cocci counts (per 100 ml) in marine and estuarine waters were as follows: Chesapeake Bay surface, 1200; Chesapeake Bay bottom, 90; Narragansett Bay, 60; Atlantic Ocean at Cape Henry, 60 near land and 20 in open ocean; and Puerto Rico, 100. Ratios of heterotrophic bacteria to Gram positive cocci wer 2600, 36700, 150, 20, 10, and 9, respectively. Staphylococcus spp. comprised 92% of Gram positive cocci, with Micrococcus (8%) and streptococcus spp. found rarely, except at the Puerto Rican Trench dump site. Staphylococci were not abundant near land. Staphylococcus hominis was dominant at all but the Narragansett Bay station, where S. epidermidis was isolated. Highest bacterial counts were found in water of lowest salinity. (Cassar-FRC)
W83-02391

DETERMINING THE CONCENTRATION OF EASILY ASSIMILABLE ORGANIC CARBON IN DRINKING WATER,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
For primary bibliographic entry see Field 5F.
W83-02397

THE EFFECT OF ENVIRONMENTAL FACTORS ON THE SUSPENDED BACTERIA IN THE WELSH RIVER DEE,
Liverpool Polytechnic (England). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W83-02402

COMPARATIVE STUDY OF CONFIRMATION MEDIA FOR DETECTING GROUP D STREPTOCOCCI,
Rijksinstituut voor de Volksgezondheid, Bilthoven (Netherlands).
A. H. Havelaar, P. D. Tips, and H. W. B. Engel.
Water Research, Vol 16, No 12, p 1605-1609, December, 1982. 6 Tab, 13 Ref.

Descriptors: *Bacteria, *Streptococcus, *Culture media, *Pollutant identification, Azide dextrose media, Bacterial analysis, Fecal bacteria, Water pollution, Wastewater pollution, Natural waters.

Four media for confirming the presence of group D streptococci in azide dextrose broth enrichment cultures at 37C were compared. The subculture systems were ethylviolet azide broth, azide dextrose broth, bile esculin azide agar, and K-F streptococcus agar. Ethylviolet azide broth at 37C failed to support growth of all group D streptococci tested and gave positive reactions with some non-group D strains. The characteristic purple button was frequently absent. Azide dextrose broth incubated at 44C also inhibited some group D streptococci and was sensitive to overgrowth by catalase-positive bacteria. Bile esculin azide agar incubated at 44C supported growth of group D almost exclusively but was the most inhibitory of all media tested in this study. K-F streptococcus agar at 37C gave positive reactions with most group D streptococci and with many non-group-D strains. The most accurate results can be obtained by using a combination of bile esculin azide agar and K-F streptococcus agar. (Cassar-FRC)
W83-02412

BACTERIOLOGICAL AND VIROLOGICAL ANALYSIS OF WATER FROM FOUR FRESH WATER BEACHES,
Institut Armand-Frappier, Laval (Quebec).
P. Payment, M. Lemieux, and M. Trudel.
Water Research, Vol 16, No 6, p 939-943, June, 1982. 5 Fig, 2 Tab, 8 Ref.

Descriptors: *Bioindicators, *Pollutant identification, *Viruses, *Turbidity, *Separation techniques, *Sewage bacteria, Water analysis, Bacteria, Salmonella, Coliforms, Streptococcus, Enteric bacteria, Beaches, Lakes, Water pollution, Quebec, Deux-Montagnes Lake.

Water samples were collected from four public beaches located on Deux-Montagnes Lake during July and August of 1979 to evaluate the extent of viral pollution in recreational waters, to study the efficiency of two viral concentration methods, and to assess the adequacy of bacterial standards to monitor viral pollution. One twenty-liter water sample was taken from each of the four locations and analyzed for total coliforms, fecal coliforms, fecal streptococci, salmonellae, and enteric viruses. Viruses were effectively concentrated by filtration on a stack of 142 millimeter-size fiberglass filter discs, followed by a hydroextraction procedure. Statistical analysis of the data showed no correlation between the presence of viruses and enteric bacteria and no correlation between the presence of salmonellae and other bacterial indicators. When turbidity was greater than 10 nephelometric turbidity units, a positive correlation between virus isolation and water turbidity was apparent. Further studies are needed to see if correlations exist between viral concentrations in public bathing waters and disease incidence. (Geiger-FRC)
W83-02417

5B. Sources Of Pollution

APPRAISAL OF GROUND-WATER QUALITY NEAR WASTEWATER-TREATMENT FACILITIES, GLACIER NATIONAL PARK, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
J. A. Moreland, and W. A. Wood.
Geological Survey Water-Resources Investigations 82-4, June 1982. 27 p, 8 Fig, 5 Tab, 1 Ref.

Descriptors: *Groundwater, *Water quality, *Data collections, *Monitoring, *Observation wells, Sites, Sampling, Trace elements, Drillers logs, Water level, Groundwater movement, Wastewater treatment, Effluents, Waste disposal, Geohydrology, *Montana, Glacier National Park.

Water-level and water-quality data were collected from monitoring wells at wastewater-treatment facilities in Glacier National Park. Five additional shallow observation wells were installed at the Glacier Park Headquarters facility to monitor water quality in the shallow ground-water system. Water-level, water-quality, and geologic information indicate that some of the initial monitoring wells are not ideally located to sample ground water most likely to be affected by waste disposal at the sites. Small differences in chemical characteristics between samples from monitor wells indicate that effluent may be affecting ground-water quality but that impacts are not significant. Future monitoring of ground-water quality could be limited to selected wells most likely to be impacted by percolating effluent. Laboratory analyses for common ions could detect future impacts. (USGS)
W83-02115

WATER-QUALITY CHARACTERISTICS OF EVERGLADES NATIONAL PARK, 1959-77, WITH REFERENCE TO THE EFFECTS OF WATER MANAGEMENT,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-228941, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-34, 1982. 51 p 15 Fig, 9 Tab, 25 Ref.

Descriptors: *Water quality, *Surface water, *Marshes, Environmental effects, Path of pollutants, Water management, Data collections, Ions, Nutrients, Pesticides, Chemical analysis, *Florida, Everglades National Park, Everglades.

The U.S. Geological Survey has collected water-quality data in the Everglades National Park since 1959. Major ions, macronutrients, trace elements, and pesticides are the primary chemical groups analyzed. The period of record and frequency of sampling vary for each chemical group, with the longest record for the major ions and the shortest for the macronutrients. Within the park there are three major drainageways: Big Cypress Swamp, Shark River Slough, and Taylor Slough. Each drainageway exhibits unique hydrologic conditions, yet there is a high degree of homogeneity in water-quality characteristics among these areas. Seasonal changes in major-ion, trace-element, and macronutrient concentrations are marked in the shallow marsh. Concentrations generally increase in the dry season due to evapotranspiration, changes in chemical equilibria, and precipitation. Water-management practices in south Florida have changed the water quality in the Shark River Slough. Most major-ion, dissolved-solid, and iron concentrations and color levels have steadily increased since 1963. The water quality in the other two drainageways has not changed since sampling began. Chlorinated-hydrocarbon insecticide residues in bottom material were found in low concentration at every sampling station in the park. (USGS)
W83-02117

ORGANIC MATTER LOADING AND PROCESSING IN A PRISTINE STREAM DRAINING A TALLGRASS PRAIRIE/RIPARIAN FOREST WATERSHED,
Kansas Water Resources Research Inst., Manhattan.
M. E. Gurtz, G. R. Marzolf, K. T. Killingbeck, D. L. Smith, and J. V. McArthur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173245, Price codes: A05 in paper copy, A01 in microfiche. Contribution No 230, November 1982. 78 p, 24 Fig, 114 Ref, 2 Append. OWRT B-063-KAN(1), 14-34-0001-0264.

Descriptors: *Organic matter, *Watersheds, Intermittent streams, Storm runoff, Riparian vegetation, Decomposition, *Organic loading, Stream banks, Ephemeral streams, Hydrographs, Seston, Throughfall, Prairie, *Litterfall, *Dissolved organic matter, *Kansas, Kings Creek watershed, *Forest watersheds, *Grasses, *Tallgrass.

The stream chosen for study lies within the Kings Creek watershed of Konza Prairie Research Natural Area, a tallgrass prairie site near Manhattan, Kansas. The primary purpose in this organic matter investigation was to provide an observational basis for future research relating to water quality. Secondly, there was need to study the ecology of the tallgrass prairie stream to evaluate present understanding of stream ecosystem. Organic matter contributions to the stream were estimated for one year. Coarse particulate allochthonous organic matter was collected as direct litterfall and lateral movement. Dissolved organic carbon entering the stream channel was estimated by collecting throughfall in areas representing the three riparian zones. Direct litterfall was contributed mostly by grasses and herbaceous vegetation. Rate of direct litterfall was highest in the gallery forest. Inputs from lateral movement were mostly grass. Most of the deciduous tree species exhibited autumn peak of direct litterfall. Wood collection differed distinctly from leaf inputs, being particularly high in summer. Grass inputs apparently were greatest during summer and early autumn. Composition of stored organic matter varied with changes in riparian vegetation along the longitudinal gradient. Grass dominated storage in the upland region, while leaves and wood were more abundant in lower reaches. Two points emerged that may be useful to improve water quality: 1. Decomposition of organic matter by native stream biota in the headwaters should be maximized. 2. Preserving natural retention structures in headwaters will maximize decomposition.
W83-02133

CAUSES OF ACIDIFICATION OF FOUR STREAMS ON LAUREL HILL IN SOUTHWESTERN PENNSYLVANIA,
Pennsylvania State Univ., University Park. School of Forest Resources.
D. R. DeWalle, W. E. Sharpe, R. S. Dinicola, R. T. Leibfried, and W. G. Kimmel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173278, Price codes: A04 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources Completion Report, Pennsylvania State Univ., University Park, December 1982. 62 p, 12 Tab, 14 Fig, 19 Ref. OWRT B-117-PA(2), 14-34-0001-0277.

Descriptors: Water quality, Streams, *Fishskills, *Storm runoff, Fish populations, Snowmelt, Snowpack pollutants, Snowpacks, Base flow, *Pennsylvania, *Hydrogen ion concentration, *Acidification, *Acid precipitation, Laurel Hill, Aluminum concentration, Buffering capacity, Atmospheric deposition, *Soil leachate, Poorly buffered streams, Geologic influences.

Possible sources of acidity were investigated for four streams on Laurel Hill (southwestern Pennsylvania) where fishkills have been reported since 1960. A study of the chemistry of atmospheric deposition, soil leachate and stream water and fish populations was conducted on these basins during 1980-81, emphasizing dormant season periods with runoff from snowmelt and rain. Although bedrock geology altered the natural buffering capacity of these streams, only acid precipitation could be linked to sharp drops in pH and increases in total aluminum concentrations observed during stormflows in the poorly-buffered streams. Three poorly-buffered streams exhibited drops to pH 4.4 - 4.5 and increases in total aluminum concentrations up to 1.5 mg/l during observed peak flows. Mineral soil leachate from the three major soil series on the basins exhibited a low pH of 4.3 and average total aluminum concentrations of 3.6 mg/l, indicating stream response during storms was closely linked to chemistry of soil leachate. Poorly-bufferred streams did not support reproducing populations of trout or other fishes. In contrast, one well-buffered stream (equivalent 20 mg/l CaCO sub 3) only exhibited drops to pH 5.5 during peak flow and supported reproducing trout and sculpin populations. The loss of fish populations in poorly-buffered streams was attributed to acidification of forest soils by precipitation.
W83-02136

CONTAMINANT LEVELS IN PRECIPITATION AND URBAN SURFACE RUNOFF,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
M. Owe, P. J. Craul, and H. G. Halverson.
Water Resources Bulletin, Vol 18, No 5, p 863-868, October, 1982. 4 Fig, 4 Tab, 22 Ref.

Descriptors: *Urban runoff, *Runoff, *Precipitation, Water pollution sources, Fate of pollutants, Metals, Hydrocarbons, Transporation, Zinc, Lead, Copper, Cadmium, Pollutant load, Fallout, *New York, Syracuse.

Heavy metals and petroleum hydrocarbons concentrations were determined in samples of precipitation and runoff collected at a shopping mall near Syracuse, New York, during 12 storms in the 1979 hydrologic year. Levels of contaimants (mg per liter) in precipitation were: Pb, 0.058-0.186; Zn, 0.047-0.183; Cu, 0.005-0.095; Cd, 0.001-004; and hydrocarbons, none. Levels of contaminants (mg per liter) in all surface runoff were: Pb, 0.74-2.97; Zn, 0.89-4.74; Cu, 0.12-1.38; Cd, 0.01-0.28; and hydrocarbons, 3.83-19.71. There was no correlation between precipitation contaminant concentrations and length of antecedent dry period. A weak inverse relationship was observed between concentraton and amount of precipitation. Poor correlations were obtained between runoff contaminant levels and length of antecedent dry period. However, the dryfall accumulation value, which accounted for different precipitation volumes and contaminant loads, was well correlated with length of antecedent dry period. Metal ions were probably derived from atmospheric fallout, from both distant sources and the automobile traffic at the mall. Hydrocarbon residues were solely the result of automobile losses. (Cassar-FRC)
W83-02156

ESTUARINE SEDIMENT CONTROLS ON TRACE METAL DISTRIBUTIONS,

Oregon State Univ., Corvallis. Dept. of Civil Engineering.
R. J. Davies-Colley, P. O. Nelson, and K. J. Williamson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175208, Price codes: A11 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-75, Oregon State University, Corvallis, January 1982. 224 p, 7 Fig, 7 Tab, 288 Ref, 4 Append. OWRT A-051-ORE(1).

Descriptors: *Trace metals, *Copper, *Cadmium, *Sediment contamination, Estuaries, Sediment Phases, Estuarine sediments, Metal uptake, Absorption, *Path of pollutants, Fate of pollutants, Water pollution sources.

The sedimentary partitioning of copper and cadmium was examined with the goal of predicting the environmental fate of these toxic metals in estuaries. Trace metal binding in oxidized sediments was simulated with five solid phases: synthetic hydrous oxides of iron and manganese, montmorillonite clay, a synthetic aluminosilicate gel, and estuarine humic sustances (EHS) extracted from a natural sediment. The uptake of copper and cadmium by these model phases in artificial seawater was measured as a function of pH and salinity. The affinity for cadmium was in the following order: manganese > iron > aluminosilicates > montmorillonite. Copper binding affinities were much higher but the relative order of affinity of the phases was similar. Metal binding was not influenced by interactions involved in iron-clay, iron-humic and clay-iron-humic phase complexes. This suggests that experiments with isolated phases are adequate to predict partitioning. A simple model was calibrated for predicting partitioning and total metal uptake by sediments. This model, predicts that cadmium uptake by estuarine sediments is dominated by iron while both iron and organics are important for copper. Selective extraction studies and studies of cadmium uptake by natural estuarine sediments give semiquantitative agreement with these predictions. In anaerobic sediments, thermodynamic calculations suggest that copper and cadmium concentrations are determined by equilibria involving solid sulphides and bisulphide and polysulphide complexes.
W83-02175

HEAVY METALS IN ACID PRECIPITATION,
Vermont Univ., Burlington. Dept. of Civil and Mechanical Engineering.
D. R. Hemenway.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175273, Price codes: A03 in paper copy, A01 in microfiche. Vermont Water Resources Research Center Completion Report, Univ. of Vermont, Burlington, December 1982. 30 p, 9 Fig, 7 Tab, 7 Ref. OWRT A-046-VT(1).

Descriptors: *Acid rain, *Acid precipitation, *Heavy metals, Aluminum, Lead, Cadmium, Vanadium, *Vermont, Sampling, Data collections, Path of pollutants, *Pollutant identification, Water pollution sources.

Precipitation samples were collected sequentially on a sub-event basis. Specific contaminants in the segmented precipitation samples were measured for seven separate events. The concentration of Al, Cd, Pb, and V in the subsamples of each event analyzed were determined along with sample pH. In the last three events, sulfate, nitrate, and chloride concentrations were also measured. The subsamples for each event were filtered through a 0.1 um membrane filter in an attempt to separate particulate matter from soluble species. Filtrate concentrations were as high as 243 ug/L, 53 ug/L, 91 ug/L and 8.3 ug/L for Al, V, Pb, and Cd, respectively, for the initial sub-sample. The only metal investigated associated with the suspended particulate was Al with concentration of up to 350 ug/L in the initial sub-samples. SO sub 4, NO sub 3, and Cl showed similar trends as pH during the course of an event. These concentrations were always high at the onset of precipitation, lowering as the event continued, but once again increasing, in differing degrees, in the final sub-samples. Results indicate that chemical constituents in precipitation vary greatly with time. Removal of certain contaminants may be greatly affected by scavenging efficiencies of cloud and rain drops, and aerodynamic and chemical behavior of the aerosol rather than simple washout/dilution effects.
W83-02182

DISTRIBUTION OF PHOSPHORUS IN COLUMNS OF VERY SANDY SOILS AFTER LEACHING WITH WATER OR DIAMMONIUM PHOSPHATE SOLUTIONS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W83-02199

PHOSPHORUS AND ORGANIC CARBON IN THE SEDIMENTS OF A POLLUTED SUBTROPICAL ESTUARY, AND THE INFLUENCE OF COASTAL RECLAMATION,
Fisheries Research Station, Aberdeen (Hong Kong).
G. B. Thompson, and S. K. Yeung.
Marine Pollution Bulletin, Vol 13, No 10, p 354-359, October, 1982. 5 Fig, 19 Ref.

Descriptors: *Phosphorus, *Harbors, *Estuaries, Sedimentation, *Sediments, Organic compounds, Water pollution effects, Phosphates, Tolo Harbour, *Hong Kong, Water quality.

Total phosphorus and organic carbon were determined in the sediments of Tolo Harbour in July 1978. The harbor is a sewage polluted estuary in north-east Hong Kong. Concentrations were correlated with the percent silt-clay in each of three areas. Phosphorus concentrations were highest in central Tolo Harbour, lower by about 1.5 microgram-atom P per g in the outer estuary, Tolo Channel, and lowest in the polluted inner reaches near large coastal reclamations. The latter values, about 3.0 microgram-atoms P per g lower than in central Tolo Harbour, might reflect a selective adsorption of phosphate by reclamation sediments. Organic carbon concentrations were high in the inner reaches and decreased towards the outer channel. Correlations between phosphorus and organic carbon were compared with a published correlation for the east coast of England. In Hong Kong the phosphorus concentration showed a smaller increase as organic carbon increased, and reached only one-third of the English values as organic carbon approached 2.0%. (Baker-FRC)
W83-02203

HEAVY METALS IN THE TIBER RIVER BASIN,
Istituto di Ricerca sulle Acque, Rome (Italy).
M. Pettine, T. La Noce, G. Macchi, and F. J. Millero.
Marine Pollution Bulletin, Vol 13, No 9, p 327-329, September, 1982. 1 Fig, 4 Tab, 15 Ref.

Descriptors: *River basins, *Heavy metals, *Pollutant identification, Water pollution sources, Metals, Cadmium, Iron, Manganese, Copper, Lead, Zinc, Suspended sediments, *Tiber River, River basins, *Italy.

Water samples were taken from the Tiber River basin and analyzed for metal content. Concentrations of metals tended to increase, generally from the upper Tiber waters to the river mouth, as a consequence of the natural process of erosion and anthropogenic activities in the basin. The increase is not very great because industrial activity in the area is not highly developed. The total concentration of metals as well as the distribution between the soluble and particulate phase at the river mouth are strongly influenced by the flow conditions and the suspended matter concentration of the river. The total concentration of metals, as well as the solid load, increases during the season of high flow conditions as a consequences of the efficiency of land drainage. The Tiber River appears not to change significantly the quality of the coastal waters in terms of the metals studied. A reassessment of heavy metals in the Mediterranean open sea waters would probably change this conclusion. (Baker-FRC)
W83-02205

THE ROLE OF LAKE AND RESERVOIR SEDIMENTS AS SINKS IN THE PERTURBED GLOBAL CARBON CYCLE,
Oak Ridge National Lab., TN.
P. J. Mulholland, and J. W. Elwood.
Tellus, Vol 34, No 5, p 490-499, October, 1982. 3 Fig, 5 Tab, 52 Ref.

Descriptors: *Sinks, *Sedimentation, *Carbon cycle, Lakes, Reservoirs, Carbon, Fuels, Sediments.

Recent increases in organic carbon accumulation in the sediments of lakes and reservoirs are estimated. The possibility that, as a result of some of man's activities, the rate of net carbon accumulation in the sediments of inland waters has increased in recent years, removing fossil fuel carbon from the atmosphere and accounting for a portion of the 'missing' carbon in current global carbon budget estimates, was investigated. The findings proved that the role of inland aquatic sediments as sinks in the global carbon cycle is significant although small compared to that of terrestrial systems and the oceans. Rates of organic carbon accumulation in the sediments of inland aquatic ecosystems appear to be related to the flushing rates of these systems. The highest accumulation rates are found in systems which have relatively large inputs of terrestrial organic matter. These systems usually have high watershed area:water surface area ratios, but also have sufficient water residence times for substantial sedimentation of allochthonous inputs and medium to high autochthonous production. (Baker-FRC)
W83-02206

RELATIONSHIP BETWEEN TOPOGRAPHIC POSITION AND CONTAMINATION OF WATER RESOURCES BY REFUSE LANDFILLS,
Iowa State Water Resources Research Inst., Ames.
L. V. A. Sendlein, R. C. Palmquist, T. E. Fenton, and L. D. Drake.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177949, Price codes: A06 in paper copy, A01 in microfiche. Publication No 65, January 1983. 106 p, 45 Fig, 16 Tab, 25 Ref. OWRT A-047-IA(3), 14-31-0001-4015, 14-31-0001-3515, 14-31-0001-3815.

Descriptors: *Landfills, *Leachates, Groundwater contamination, *Iowa, *Illinois, *Path of pollutants, Waste disposal, Land disposal, Topography, Sites, Fate of pollutants.

Several upland and floodplain sanitary landfill sites were investigated to determine the size, shape and composition of the leachate plume. Movement of pollutants was found to be parallel to the flow lines in a compact, flume-shaped malenclave. Leachate concentrations are highest along an axis parallel to the groundwater flow lines. The closer the disposal site to a river the minimum the area of contaminated groundwater. In upland sites, migration was primarily downward with little lateral migration. No significant adverse effect of leachate on surface water quality was determined.
W83-02209

CHEMICAL AND MICROBIOLOGICAL COMPOSITION OF DRAINAGE WATERS IN FLOODPLAIN SOILS BEING DRAINED,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Tomsk (USSR).
L. I. Inisheva, and A. N. Vasil'eva.
Water Resources (English Translation), Vol 9, No 1, p 98-104, January/February, 1982. 3 Fig, 3 Tab, 9 Ref. Translated from Vodnye Resursy, No 1, p 147-153, January/February, 1982.

Descriptors: *Drainage water, *Microorganisms, *Chemical analysis, Water analysis, Water quality, Drainage, Surface waters, Floodplains, Land reclamation, Surface runoff, Soils, Oxidation, *USSR, Kiya River.

Investigations of the chemical composition of drainage waters were carried out in the subtaiga zone, in the floodplain of the Kiya river in the Zyryansk region of the Tomsk district on a polder-

type land reclamation project. Tile drainage was constructed on the system in 1974-76. The study concluded that in the floodplain soils the mobility of the main nutrients and also of calcium, magnesium, iron, sulfates, and bicarbonates is limited. Peat bog soils were distinguished by a higher content of available forms of the given elements. This is one of the reasons for the evaluated concentrations of these elements found in the drainage waters of these soils. In intensely drained soils the content of available forms of chemical compounds increased under the effect of aerobic soil biota, which promoted their removal with the drainage runoff. To prevent the decomposition of peat to water-soluble compounds, the moisture content of the reclaimed soils should be kept close to the field capacity for the greater part of the growing season, which will equalize the ratio of aerobic and anaerobic microflora. (Baker-FRC)
W83-02256

DIFFUSION OF A PASSIVE SCALAR WITH RANDOM ADVECTION,
Oak Ridge National Lab., TN.
J. E. Molyneux, and A. J. Witten.
Water Resources Research, Vol 16, No 1, p 137-144, February, 1980. 4 Fig, 9 Ref.

Descriptors: *Solute transport, *Stochastic process, *River flow, Fate of pollutants, Flow velocity, Probabilistic process, Statistical analysis, *Path of pollutants, Model studies, Advection, Passive scalers.

The instantaneous release of a passive (nonreacting) additive into a flow is investigated, assuming that the concentration of the additive is governed by the one-dimensional advective diffusion equation in which the advecting flow velocity is a given time-dependent stochastic process. Both one- and two-space-time point probability distributions of the random concentration field were determined. This problem is an idealized model of accidental or planned release of contaminants into a river by a power station or other source. Previous treatments of this problem have focused on deriving information about the statistical moments of the concentration. This paper shows a more complete statistical description. In the case of accidental releases of pollutants, the time of release and river flow are unknown. Using results obtained in this paper and long-term statistics of river flow, the impact of the accident can be assessed probabilistically. (Cassar-FRC)
W83-02265

PETROLEUM HYDROCARBONS IN URBAN RUNOFF FROM A COMMERCIAL LAND USE AREA,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
E. J. Hoffman, J. S. Latimer, G. L. Mills, and J. G. Quinn.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1517-1525, November, 1982. 6 Fig, 9 Tab, 27 Ref.

Descriptors: *Hydrocarbons, *Urban runoff, *Storm water, Runoff, Fate of pollutants, Water pollution sources, Rain storms, Suspended solids, Particulate matter, Paving, Oil pollution, *Rhode Island.

Petroleum hydrocarbons were determined in storm runoff from a shopping mall in Warwick, Rhode Island. The samples were collected during 6 rainstorms lasting from 1.5 to 13 hours and depositing 0.05 to 1.60 inches of rainfall. The loads of suspended solids (SS) and hydrocarbons varies widely over the progress of a storm, highest concentrations and loads being associated with the first flush (first major peak in flow rate). SS concentrations (in mg per liter) ranged from 1.6 to 12.0 minimum and 47.5 to 252.0 maximum (flow weighted means, 20.5-112.7 mg per liter). Total hydrocarbons concentrations (mg per liter) were: 0.059-0.450 minimum to 1.13-5.70 maximum (flow weighted means, 0.69-2.15). Loading was essentially linear with total rainfall, suggesting that the supply of pollutants had not been exhausted in storms up to the largest (1.60 in) but could approach a limit in storms > 1.90 in. Between 83 and 93% of total hydrocarbons were associated with the particulates. These solids contained 1.7-33% hydrocarbons. Gas chromatographs of the runoff hydrocarbons and automotive crankcase oil were very similar. (Cassar-FRC)
W83-02281

USE OF ATMOSPHERIC FLUOROCARBONS F-11 AND F-12 TO DETERMINE THE DIFFUSION PARAMETERS OF THE UNSATURATED ZONE IN THE SOUTHERN HIGH PLAINS OF TEXAS,
Geological Survey, Lakewood, CO. Water Resources Div.
E. P. Weeks, D. E. Earp, and G. M. Thompson.
Water Resources Research, Vol 18, No 5, p 1365-1378, October, 1982. 7 Fig, 4 Tab, 44 Ref.

Descriptors: *Fluorocarbons, *Soil gases, *Tracers, *Organic compounds, Diffusion, *Texas, Tortuosity, Sorption, Model studies, Porous media, Gas transport, Porosity, Water table decline, Dating, Groundwater dating, High Plains, *Path of pollutants, Radioactivity.

Studies of the diffusive movement of volatile solutes through the unsaturated zone are important in hydrologic research because the evaluated parameters affect the movement and distribution of volatile organic or radioactive contaminants from the land surface to the groundwater reservoir, or from buried waste to the land surface. These studies may also aid in interpreting groundwater ages based on the presence of atmospheric gases. Trichlorofluoromethane (F-11) and dichlorodifluoromethane (F-12) were measured in soil air in the unconsolidated sedimentary deposits at four sites in the Amarillo-Lubbock region of semiarid Texas. At the relatively undisturbed Glenn site, fluorocarbon concentrations of soil gas decreased with depth; the F-12/F-11 ratio also increased with depth. Fluorocarbon concentrations at the other three sites did not show the expected pattern due to effects of other experiments or a perched groundwater body. An analytical model and a finite-difference model, both based on molecular diffusion theory, were used to assess the field results. Effective diffusion coefficients were 0.04 sq m per day (F-11) and 0.09 sq m per day (F-12), compared with the theoretical values of 0.78 and 0.86 sq m per day in free air. This demostrated the combined effects of tortuosity, solubility, and sorption in retarding the transport of fluorocarbons through the unsaturated zone. Tortuosity values depended on the distribution coefficient used and were affected by solid-gas partitioning but not by moisture content or drained porosity. Tortuosity values and numerical modeling of results agreed closely with values calculated from published theoretical and empirical relationships. (Cassar-FRC)
W83-02289

BIOGEOCHEMISTRY OF ARSENIC MINE DRAINAGE,
Alaska Univ., Fairbanks. Inst. of Water Resources.
H. V. Luong, J. M. Forshaug, and E. J. Brown.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-180273, Price codes: A02 in paper copy, A01 in microfiche. Completion Report 79-21, November 1981. 20 p, 1 Fig, 2 Tab, 6 Ref. 1 Append. OWRT B-045-ALAS(1), 14-34-0001-0202.

Descriptors: *Arsenic compounds, *Mine drainage, Mine water, Mining, *Gold, Hydraulic mining, *Placer mining, Lode mining, *Thiobacillus spp., *Alaska, Aquatic bacteria.

Arsenic is enriched in gold and sulfide deposits throughout many areas of Alaska. Consequently, some stream waters, stream sediments and groundwaters contain dissolved arsenic concentrations in excess of the Environmental Protection Agency's recommended limit of 50 parts per billion (pbb: Wilson and Hawkins, 1978) We report here that the acidiophile, T. ferrooxidans is present in most neutral pH subarctic streams affected by gold mining activities. Some of these streams have measurable levels of dissolved arsenic while others do not. We also report that the presence of T. ferrooxidans increases the rate that arsenic leaches from gold-bearing material at least fourfold over the abiotic leaching rate. In summary, we have found that high numbers of acidophilic bacteria exist in mine drainage that contains arsenic. This provides indirect evidence that microbial activity is associated with increased levels of arsenic in streams and groundwaters. Heavy metal leaching may yet prove to be from localized pyritic material via the conventional 'acid-mine drainage' mechanisms, via some as yet undiscovered biochemical mechanism, or even via a strict chemical equilibrium process in the presence of incidental populations of T. ferrooxidans. Whatever the mechanism of heavy metal leaching in the areas described, mining activity continues to increase. We feel, therefore, that studies of the biogeochemistry of those areas should continue.
W83-02290

TOXAPHENE,
California State Water Resources Control Board, Sacramento.
D. B. Cohen, G. W. Bowes, and S. M. Ali.
Special Projects Report No 82-4SP, June 1982. 126 p, 17 Fig, 35 Tab, 140 Ref, 9 Append.

Descriptors: *Chemical wastes, *Agricultural wastes, *Insecticides, *Pesticides, *Toxicity, Contamination, Volatility, Aquatic environment, Aquatic life, Sediments, Carcinogens, Nonpoint pollution sources, DDT, Polychlorinated biphenyls, Pollutants, Fishkill.

Toxaphene, a potent insecticide, has been detected in parts of the world far from areas of use and may be as significant a global contaminant as DDT and PCB. Its use has been banned in the U.S. and in some countries. Use in California has declined from 3 million pounds in 1973 to 0.5 million pounds in 1980. Toxaphene enters the atmosphere primarily via drift from aerial applications and volatilization from soil, water and plant canopy. the most significant impact on beneficial uses of water is its toxicity to aquatic life. It is chronically toxic at extremely low concentrations and acutely toxic to freshwater fish at low parts per billion levels. Mean residue concentrations in fish have increased since 1970. Little is known about toxaphene's toxicity to humans but it was determined to be an animal carcinogen. Point source discharges can occur from manufacturers, formulators and applicators. Non-point source losses to the atmosphere have been estimated to average over 60% of the material applied. Every effort needs to be made to mitigate further contamination of the environment, such as by soil and water conservation to minimize runoff and soil loss, installing sediment traps below treated water shed areas, and using different insecticides. Recommendations are suggested for many state and federal agencies, including California's Water Resources Control Board and the Regional Water Quality Control Boards, the U.S. EPA, the U.S. Fish and Wildlife Service, Department of Food and Agriculture, and the Department of Health Services. (Atkins-Omniplan)
W83-02299

CHARACTERISTICS OF MUNICIPAL WASTEWATERS,
Southern California Coastal Water Research Project Authority, Long Beach.
For primary bibliographic entry see Field 5A.
W83-02301

METAL INPUT AND MOBILIZATION IN TWO ACID-STRESSED LAKE WATERSHEDS IN MAINE,
Maine Univ. at Orono. Land and Water Resources Center.
J. S. Kahl.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182022, Price codes: A06 in paper copy, A01 in microfiche. M.S. Thesis, December 1982. 108 p, 28 Fig, 16 Tab, 123 Ref, 4 Append. OWRT A-053-ME(1).

Descriptors: *Acid rain, Forest soils, *Heavy metals, Sediment-water interfaces, *Maine, Lake watersheds, *Acid-stressed lakes, *Precipitation

chemistry, *Sediment chemistry, Surface water chemistry, Acidified waters, Buffering, Soil profiles, Soil cores.

Two small lakes in Hancock County (ME), Little Long Pond and Second Pond, were compared with respect to atmospheric deposition, aqueous chemistry, and metal mobilization from sediments. The ponds have similar granitic bedrock, elevation, watershed areas, soil composition, and atmospheric deposition of acids and metals, but they exhibit marked differences in surface water pH. Little Long Pond is acidic (pH 4.5-5.6), whereas Second Pond is circumneutral (pH 6.0-6.8) and has higher dissolved cation concentrations. These differences are caused at least in part, by thinner soils, greater relief, and more exposed bedrock in Little Long watershed, compared to Second Pond watershed. Dated sediment chemical profiles indicate that accelerated sedimentation of PB and Zn began in the mid-1800's in both ponds, presumably due to increased atmospheric deposition. Little Long Hypolimnetic sediments show concurrent depletion in Ca, Mn, and more recently, Zn. Experiments with limnocosms show that up to 50% of the Ca and Mn, and 25% of the Zn, in recent sediments may be leached at a pH near 4.0 in less than a year, suggesting that in-situ leaching may be an important influence on sediment chemistry in acidic waters. Nearly 10% of the Ca and Zn was mobilized at pH 5.0. Except for the epilimnetic Little Long cores (greater Mn release), and the hypolimnetic Little Long cores (less Ca release), the sediments from different sites and lakes responded similarly to experimental acidification in the laboratory. However, Al release by Little Long sediments was relatively more important in buffering acid inputs, whereas Ca was more important in Second Pond sediments.
W83-02328

CHEMICAL TRANSPORT IN A FISSURED ROCK: VERIFICATION OF A NUMERICAL MODEL,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
A. Rasmuson, T. N. Narasimhan, and I. Neretnieks.
Water Resources Research, Vol 18, No 5, p 1479-1492, October 1982. 15 Fig, 4 Tab, 22 Ref.

Descriptors: *Model studies, *Geologic fractures, *Waste storage, *Radioactive wastes, *Advection, Diffusion, Computers, Mathematical equations, *Advective diffusion equation.

A numerical model, TRUMP, has been verified which solves the advective diffusion equation in general three dimensions, with or without decay and source terms. The method is based on an intergrated finite difference approach. The model was verified against known analytic solutions of the one-dimensional advection-diffusion problem, as well as the problem of advection-diffusion in a system of parallel fractures separated by spherical particles. The studies show that as long as the magnitude of advectance is equal to or less than that of conductance for the closed surface bounding any volume element in the region, the numerical method can indeed match the analytic solutions. The realistic input parameters used in the sample calculations suggest that such a range of Peclet numbers is likely to characterize deep groundwater systems in granitic and ancient argillaceous systems. Thus TRUMP provides a viable tool for use in nuclear waste evaluation studies. A disadvantage of TRUMP is that the iterative method of solving the set of simultaneous equations is rather slow when time constants vary widely over the flow region. Although the iterative solution may be very desirable for large three-dimensional problems to minimize computer storage, it seems desirable to use a direct solver technique in conjunction with the mixed explicit-implicit approach whenever possible. (Baker-FRC)
W83-02349

ENVIRONMENTAL ASPECTS OF ORGANICS IN SELECTED COAL CONVERSION SOLID WASTES,
Oak Ridge National Lab., TN.
M. G. Browman, and M. P. Maskarinec.
Journal of Environmental Science nd Health, Part A, Vol 17, No 5, p 737-766, 1982. 1 Fig, 7 Tab, 31 Ref.

Descriptors: *Organic compounds, *Coal gasification, *Waste characteristics, Aromatic compounds, Aliphatic compounds, Polynuclear aromatic hydrocarbons, Coal liquefaction, Fly ash, Industrial wastes, Waste storage, Leachates, Hydrocarbons, Pollutant identification.

The speciation and quantities of organic compounds were determined in selected coal conversion wastes: ash, char, and/or slag from 8 medium/high Btu gasification processes and temporarily stored liquefaction solids (vacuum still bottoms and a spent product-filter material). Entrained-flow, fixed bed, and fluidized bed process wastes were represented. Extracts of the materials were prepared by continuous methylene chloride extraction for 18 hours and by stirring with water for 24 hours. In general, organic concentrations were much lower in gasification wastes than in the temporarily stored liquefaction solids. Recovery of added benz(a)anthracene by methylene chloride extraction ranged from 2.5 to 100%. Gasification wastes contained 0-6.3 micrograms per g methylene chloride extractable aromatics and 0-70 micrograms per g aliphatic hydrocarbons. The liquefaction solids contained 75-760 and 260-1300 micrograms per g aromatic and aliphatic hydrocarbons, respectively. Aqueous extracts of the wastes contained 0.2-2.1 mg per liter dissolved organic carbon, except for one liquefaction waste sample with 90 mg per liter dissolved organic carbon. The pH values of the aqueous extracts were 3.9-9.8. The phenols and cresols in the temporarily stored spent product-filter material could degrade surface and groundwater quality if exposed to the weather. All other materials were considered no significant threat to water quality. (Cassar-FRC)
W83-02357

NUTRIENT REMOVAL AND LEACHING FROM A WHOLE-TREE HARVEST OF NORTHERN HARDWOODS,
Northeastern Forest Experiment Station, Durham, NH. Forestry Sciences Lab.
J. W. Hornbeck, and W. Kropelin.
Journal of Environmental Quality, Vol 11, No 2, p 309-316, April-June, 1982. 3 Fig, 4 Tab, 25 Ref.

Descriptors: *Erosion, *Nutrient removal, *Forest management, Leaching, Nitrate, Soil solution, Calcium, Potassium, Phosphorus, Nitrogen, Water pollution, Watersheds, Biomass, Hardwood, *New Hampshire.

Whole-tree harvesting of northern hardwood stands in New England at shortened intervals has raised concerns about nutrient depletion, leaching of nutrients into streams, and possible declines in site productivity. Whole-tree harvesting at the site investigated resulted in the removal of an average of 111 dry metric tons of biomass per hectare, representing about 95% of the above ground total. Nutrient removal in the harvested trees averaged 344, 242, 128, and 19 kilograms per hectare for calcium, nitrogen, potassium, and phosphorus, respectively, which was between 1 and 3% of the estimated total soil capital for these nutrients. About 30% of the total estimated available calcium capital and about 85% of the total estimated available potassium captial was removed. Nitrate (N03), calcium, and potassium concentrations in soil solution and streamflow of the harvested watershed increased for about 2 years. Concentrations of both nitrate and calcium returned to background levels in the soil solution by the third growing season after the harvest. Increased mineralization and nitrification immediately after harvest are thought to cause the increases in nutrient ions in streams and soil solution. The nutrient removal and leaching losses in themselves do not seem to deplete total nutrient capital significantly, but the whole-tree harvesting method may affect the processes, mechanisms, and rates by which these nutrients are made available for future stands. (Carroll-FRC)
W83-02359

AMMONIUM IN THE DUWAMISH ESTUARY: NITRIFICATION, SEDIMENT RELEASE AND TOXICITY,
Washington Univ., Seattle. Dept. of Civil Engineering.
W. T. Trial, and E. B. Welch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182105, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Series Technical Report No 78, University of Washington, Seattle, July 1982. 87 p, 26 Fig, 7 Tab, 56 Ref, 3 Append. OWRT A-109-WASH(1).

Descriptors: *Ammonium, *Nitrifying bacteria, *Estuary, *Sediments, Water column, *Washington, Duwamish Estuary, Seattle, *Nitrification, *Toxicity, Path of pollutants, Water pollution effects.

Ammonium in the Duwamish Estuary, Seattle was examined using data obtained from laboratory and field measurements. The isolation of nitrifying bacteria by the MPN technique showed these organisms to be primarily associated with estuary sediments rather than the water column. The rate of nitrification in the estuary determined in situ was calculated based on the increased in nitrite (NO2) and Nitrate (NO3) nitrogen during a time of travel survey down the estuary. This rate was considered to be best represented by a zero order sediment based process and expressed on an areal basis as 970 milligrams per square meter per day. Using this rate over the study reach, 13% of the non-dilutional decrease in ammonium concentration could be accounted for while a 19% decrease in ammonium was observed. Nitrification in vitro was determined in chambers containing water and sediment collected from the estuary. Rates of nitrification were observed to decrease when sediments of the lower estuary were in contact with low (4%) versus high (20%) salinity water. Interstitial ammonium in sediments of the lower study reach (below kilometer 10) was shown to be higher than that in the overlying water column while this gradient was reversed in the upper study reach (kilometer 21-10). Experimental results in vitro showed sediments of the lower estuary to release ammonium to the water column. An increase in the concentration of unionized ammonia (NH3) was calculated based on the projected increase of secondary effluent discharged to the estuary. An increase in NH3 to toxic levels may occur but only if phytoplankton bloom activity increased instream pH to 8.5 or greater.
W83-02368

IMPACTS OF INDIVIDUAL ON-SITE SEWAGE DISPOSAL FACILITIES ON MOUNTAIN VALLEYS - PHASE I,
Idaho Univ., Moscow.
For primary bibliographic entry see Field 5E.
W83-02372

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES III HARTENBOS, LITTLE BRAK AND GREAT BRAK RIVERS (MOSSEL BAY),
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
R. J. Watling, and H. R. Watling.
Water SA, Vol 8, No 2, p 108-113, April, 1982. 1 Fig, 5 Tab, 6 Ref.

Descriptors: *Water pollution effects, *Water pollution sources, *Metals, *Chromium, *Estuaries, *Industrial wastes, Baseline studies, *Sediments, Heavy metals, Monitoring, Trace metals, Trace elements, Water analysis, Fate of pollutants, Core logging, Rivers, *South Africa, Mossel Bay.

Surveys were conducted in July 1978 to study the metal contents of the Hartenbos, Little Brak and Great Brak Rivers which empty from urban and industrial settlements into Mossel Bay. Water samples were analyzed for 13 elements, and surface sediments and sediment core samples for 16 elements by atomic absorption spectroscopy. Data were analyzed for absolute metal concentrations as well as inter-element relationships. Results show that all three South African rivers suffer from some degree of metal contamination. The extreme-

ly high chromium levels in parts of the Great Brak River could present a threat to estuarine flora and fauna if mobilized by flooding. However, other metal levels in this and the other two rivers do not, at present, pose a significant pollution threat. These findings may serve as a baseline reference for further pollution monitoring. (Geiger-FRC)
W83-02376

SOLIDS CONTAMINATION RESULTING FROM DRAINAGE WORKS IN AN UPLAND CATCHMENT, AND ITS REMOVAL BY FLOTATION,
Yorkshire Water Authority (England).
For primary bibliographic entry see Field 5F.
W83-02377

GROUNDWATER POLLUTION: A CASE STUDY,
Waterloo Regional Municipality (Ontario). Marshland Centre.
For primary bibliographic entry see Field 5G.
W83-02378

DISTRIBUTION OF NUTRIENT SALTS IN THE LOWER REACHES OF THE TIGRIS AND EUPHRATES, IRAQ,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad.
Water Supply and Management, Vol 6, No 5, p 443-453, 1982. 3 Fig, 2 Tab, 35 Ref.

Descriptors: *Nutrients, *Seasonal variation, *Nitrates, *Nitrites, *Phosphates, *Silicates, Rivers, Fate of pollutants, Tigris River, Euphrates River, Shatt al-Arab, *Iraq, Phytoplankton, Suspended sediments, Water pollution sources, *Path of pollutants.

Nutrients were determined in water samples collected on the surface, middle, and bottom at four stations in the Tigris-Euphrates-Shatt al-Arab river system during January, April, August, and October 1974. Nitrates were absent in April and in all but the middle and bottom samples at one station in January. The low levels were a result of adsorption onto flood-carried sediments, use by phytoplankton, and increases in nitrate reduction. High levels were caused by sewage input, agricultural runoff, and decomposition of organic matter. Nitrate levels increased to 62.0-159.5 micrograms per liter in August and 35.4-443.0 micrograms per liter in October. Nitrites were present throughout the year in all samples. Levels were lowest in April (13.2-26.3 micrograms per liter) and August (13.2-19.7 micrograms per liter) and higher in January (19.7-46.1 micrograms per liter) and October (19.7-39.5 micrograms per liter). Nitrite levels were lower during the high temperature months when transformations to nitrate or ammonia were active. High levels were a result of reduction of nitrate and nitrification of ammonia. Phosphates were absent in April due to adsorption onto suspended sediments and uptake by phytoplankton. High values in October (150-240 micrograms per liter) were related to paper factory discharges and releases from decaying organic matter and bottom sediments. Silicates varied from 3.10-4.60 micrograms per liter in January to 8.77-8.99 micrograms per liter in August. These concentrations were related to the diatom population and mixing. The large pollutant load (industrial effluents, untreated domestic wastes, and agricultural runoff) discharged into Shatt al-Arab is expected to increase with further development. Water pollution controls are suggested to minimize the further deterioration of the rivers. (Cassar-FRC)
W83-02380

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES IV KEURBOOMS AND BIETOU RIVERS (PLETTENBERG LAGOON),
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
R. J. Watling, and H. R. Watling.
Water SA, Vol 8, No 2, p 114-119, April, 1982. 1 Fig, 6 Tab, 6 Ref.

Descriptors: *Metals, *Water pollution sources, *Monitoring, *Water analysis, *Estuaries, Baseline studies, *Urbanization, Heavy metals, Trace metals, Trace elements, Fate of pollutants, Sediments, Core logging, Rivers, South Africa, Plettenberg Lagoon.

Water, surface sediment, and sediment core samples were taken in July 1978 from the Keurbooms and Bietou Rivers and analyzed for several metals by atomic absorption spectroscopy. The data will serve as baseline information for future monitoring surveys as further urbanization of the Plettenberg Lagoon area occurs. Results were analyzed for absolute metal concentrations as well as inter-element relationships. The present findings show that these rivers and their common estuary are not significantly contaminated by metals. Considerable metal loading in the Bietou River was attributed to geochemical sources, while metal build-up in the southwestern section of the estuary adjacent to the town of Plettenberg Bay was most likely caused by urban development. (Geiger-FRC)
W83-02390

MOVEMENT OF ORGANIC CONTAMINANTS IN GROUNDWATER: IMPLICATIONS FOR WATER SUPPLY,
Stanford Univ., CA. Dept. of Environmental Engineering.
P. V. Roberts, M. Reinhard, and A. J. Valocchi.
Journal of the American Water Works Association, Vol 74, No 8, p 408-413, August, 1982. 5 Fig, 1 Tab, 32 Ref.

Descriptors: *Groundwater pollution, *Organic compounds, *Sorption, *Advection, *Degradation, Adsorption, Air-water interfaces, Aquifer, Organic carbon, Molecular structure, Water pollution sources, Reviews, *Path of pollutants, Octanol.

The occurence, behavior, and treatment of contamination of groundwater by organic compounds are reviewed. Organic solute behavior in groundwater includes sorption, dispersion, advection, and degradation. Transport equations are presented. Treatment of organic contaminants is influenced by the octanol: water partition, air stripping, and adsorption. Advection and dispersion of organics in the subsurface cannot be predicted accurately but must be measured by means of tracer experiments in the field. Sorption can be predicted based on the octanol:water partition of the solute and the organic carbon content of the aquifer material. Degradation rates are dependent upon molecular structure and environmental conditions. Stimulus-response experiments are useful, as they can provide information on the behavior of organic solutes in the sub-surface environment. Knowledge of the solute transport rate and dynamic behavior are necessary for the design of groundwater quality monitoring systems. (Small-FRC)
W83-02399

PRINCIPLES OF ORGANIC CONTAMINANT BEHAVIOR DURING ARTIFICIAL RECHARGE,
Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts, and A. J. Valocchi.
The Science of the Total Environment, Vol 21, 1981. p 161-172. OWRT C-80264-R(8842)(1).

Descriptors: *Groundwater, Data collections, *Porous media, Water quality, Aquifers, *Dispersion, *Artificial recharge, *Path of pollutants, *Attenuation, *Retardation factor, *Organic chemicals, Water pollution sources.

The behavior of a variety of organic contaminants having low molecular weight has been observed during groundwater recharge with reclaimed water. The evidence is site-specific, but is believed to have broader implications regarding the general behavior or organic contaminants in groundwater. The movement of specific contaminants such as chloroform and chlorobenzene is retarded with respect to that of a conservative tracer such as chloride. The measured retardation factors are approximately 3 and 35 for chloroform and chlorobenzene, respectively. The retardation is caused by the sorption of the solute, apparently by the organic constituents of the soil material. The magnitude of the retardation factor of an organic solute can be predicted approximately from knowledge of the organic carbon content of the aquifer material and the octanol-water partition coefficient of the solute. Sorption also contributes to attenuation (damping) of concentration fluctuations. It is shown that the degree of attenuation depends strongly on the retardation factor, the distance traveled, and the hydrogeologic characteristics of the aquifer. There is evidence of biodegradation of organic solutes in the vicinity of the recharge well.
W83-02405

BACTERIAL DEGRADATION OF COAL CONVERSION BY-PRODUCTS (POLYCYCLIC AROMATIC HYDROCARBONS) IN AQUATIC ENVIRONMENTS,
Tennessee Univ., Knoxville. Dept. of Microbiology.
G. S. Sayler, and T. W. Sherrill.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187161, Price codes: A05 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center Research Report No 89, Univ. of Tennessee, Knoxville, 1982. 80 p, 4 Fig, 26 Tab, 35 Ref. OWRT B-040-TENN(3), 14-34-0001-9096.

Descriptors: Hydrocarbons, Degradation, Aquatic environment, *Biodegradation mineralization, *Microbial degradation, Metabolism, Carcinogens, Tenax, Phenanthrene, Reservoirs, Tennessee, Naphthalene, Benzo (a) pyrene, *Aromatic hydrocarbons, *Polyaromatic hydrocarbons.

Studies were undertaken to determine the potential for degradation of polyaromatic hydrocarbons (PAH) by the naturally occuring microbial populations in aquatic environments. The investigation utilized laboratory and field studies to assess the PAH biodegradative capabilities of water column and sediment samples. Phenanthrene was incubated with water samples in order to evaluate the potential for significant PAH degradation by the indigenous microbial populations. Biodegradation was assessed by comparison of total PAH substrate recovery in degradation flasks relative to sterile control flasks. A rapid Tenax-GC extraction technique was evaluated and found to be quantitatively efficient and reproducible for PHE. Nephthalene (NAP), PHE and benzo (a) pyrene (BP) were employed as substrates for PAH boidegration by microbial populations in sediments. Biodegration was assessed by mineralization of the 14C-PAH substrates incubated in sediment slurries. Mineralization rate constants and substrate turnover times were calculated for the PAH mineralization studies. Sediment microcosms treated with individual PAH or a synthetic oil (SO) were sampled after various periods of acclimation to determine the effect upon the PAH mineralization while BP was inhibitory. The SO treatment caused a substantial enhancement of PAH mineralization. PAH mineralization in sediments was related to the length of incubation time, temperature, molecular size of the substrate, bacterial populations and previous treatment with PAH or related contaminants. Lower molecular weight PAH are subject to biodegration in aquatic environments, while larger PAH are more resistant to microbial decomposition.
W83-02409

MICROBIAL UPTAKE OF CADMIUM AND ITS EFFECTS ON THE BIOCHEMICAL OXYGEN DEMAND AT VARIOUS TEMPERATURES,
Aligarh Muslim Univ. (India). Environmental Research Lab.
M. Ajmal, A. Ahmad, and A. A. Nomani.
Water Research, Vol 16, No 12, p 1611-1614, December 1982. 2 Fig, 4 Tab, 17 Ref.

Descriptors: *Cadmium, *Bacteria, *Accumulation, Fate of pollutants, Metals, Heavy metals, *Sewage bacteria, Bioaccumulation, Water pollution effects, *Biochemical oxygen demand, Temperature.

Removal of cadmium from water by sewage bacteria was studied at pH 7 using glycine as a carbon source. Temperatures were 20, 30, 40 and 50C; Cd concentrations (mg per liter) were 0.0437 (control),

0.437, 0.875, and 1.31. The rate constant and ultimate BOD were used as measures of the toxic effects. After 8 days the percentages of Cd consumed were: 21.8-24.7% at 20C, 24.76-31.46% at 30C, 29.64-32.40 at 40C, and 14.04-19.67 at 50C. The rate constants decreased with increasing Cd concentration. Rate constants on the first day of incubation at the control Cd concentration were 0.174 for 20C, 0.203 for 30C, 0.205 for 40C, and 0.197 for 50C. (Cassar-FRC)
W83-02414

POLLUTION PATTERN SURVEILLANCE ON A RIVER USED AS A DRINKING WATER SOURCE: THE RIVER MEUSE,
Antwerpse Waterwerken (Belgium). Labs. Dept.
W. Van Craenenbroeck.
Water Research, Vol 16, No 12, p 1577-1589, December, 1982. 17 Fig, 4 Tab, 18 Ref.

Descriptors: *Monitoring, *Self-purification, *Pollution load, Meuse River, *Belgium, The Netherlands, Fate of pollutants, Water pollution sources, Thermal pollution, Thermal discharges, Heated water, Cooling water, Suspended solids, Organic matter, Salts, Chlorides, Water temperature, Temperature, Nutrients, Nitrogen, Ammonia, Phosphorus, Water supply.

A comprehensive water quality surveillance system for the River Meuse, Belgium-Netherlands, was established during the early 1960's. The system now includes 18 sampling points on the river and associated canals. At several major sampling points water is analyzed weekly for 50 parameters; at minor sampling points, monthly for 10 parameters. Most sampling points are impacted by cooling water discharges, which favor growth of pathogenic organisms. Suspended solids levels (maximum in late fall) are strongly influenced by conveyance of coal particulates, dredging, and navigation. Annual, weekly, and daily cycles in suspended solids concentrations are apparent. Levels of organic substances reflect inputs from industries and rivers, natural humic substances, regions of self-purification, and seasonal variations. Levels of nutrients, derived from coke oven effluents (ammonia), sewage, and agricultural sources, are affected by river flow volumes. Mean N load in the Meuse for 1962-78 was 70 tons per day, maximum 140 tons per day in 1965 and 1970. Mean P load was about 3 tons per day during 1962-71 and 10 tons per day during 1972-78. Of the various cations and anions represented in the river water, chloride is most important. Mean chloride mass flow was 664 tons per day in 1962-80. Soda and chlorine factories discharge significant quantities of sodium and calcium chlorides. The accumulation of data from this surveillance program allows formation of a predictive model for raw water quality at various water supply intakes. (Cassar-FRC)
W83-02415

PARTITIONING OF C14 PCB BETWEEN WATER AND PARTICULATES WITH VARIOUS ORGANIC CONTENTS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
G. M. Nau-Ritter, C. F. Wurster, and R. G. Rowland.
Water Research, Vol 16, No 12, p 1615-1618, December, 1982. 1 Fig, 2 Tab, 21 Ref.

Descriptors: *Polychlorinated biphenyls, *Solubility, *Particulate matter, Fate of pollutants, Organic compounds, Chlorinated hydrocarbons, Partition coefficients, Adsorption, Organic matter, Suspended sediments, *Illite, Sea water.

Concentration factors (all times 10,000) for C14-labeled polychlorinated biphenyls (PCB) onto particulates in seawater were: 1.09 for 100% illite, 1.16 for 95%-5% illite-organic matter; 1.33 for 90%-10% illite-organic matter; and 4.92 for 100% organic matter. Desorption of the PCB-contaminated particles resuspended in clean water was rapid for 1.5 to 2 hours, then reached equilibrium. After desorption, 100% organic matter had significantly higher PCB contents than 100% illite. (Cassar-FRC)
W83-02416

TRITIUM IN GROUNDWATERS OF THE CENTRAL SECTION OF THE BAIKAL-AMUR MAIN LINE ROUTE,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. V. Romanov, V. A. Pavlov, V. A. Petrukhin, E. I. Andrievskii, and A. P. Malykhin.
Water Resources, Vol 9, No 1, p 22-26, January-February, 1982. 1 Fig, 3 Tab, 8 Ref. Translated from Vodnye Resursy, No 1, p 48-53, January-February, 1982.

Descriptors: *Groundwater movement, *Tritium, *Water exchange, Precipitation, Radioisotopes, Groundwater dating, Baikal-Amur Railroad, *USSR, Fate of pollutants, Recharge, Groundwater recharge.

Tritium levels were investigated in groundwater of the central section of the Baikal-Amur railroad line, USSR, in July 1977 and May 1979 to acquire information on the quality and hydrodynamic regime of these potable supplies. Tritium concentrations at 16 wells and springs were several orders lower than maximum levels specified in drinking water standards. The times of exchange of groundwater in this region estimated with 3 models were 30-50 years. Therefore the entry of polluted surface waters can have significant effects on aquifers. In the most intensely exploited groundwater fields there were larger differences between tritium levels between 1977 and 1979. Exchange times were 30-40 years. Intense exploitation disrupts natural recharge and can capture surface water or water from lower-lying aquifers. (Cassar-FRC)
W83-02443

THE WHANGAEHU RIVER - AN ACID BATH,
Rangitikei-Wanganui Catchment Board (New Zealand).
C. Fowles.
Soil and Water, Vol 17, No 2, p 27-29, April, 1981. 1 Fig, 2 Tab, 3 Ref.

Descriptors: *Water quality, *Rivers, *Acidic water, *Seasonal variation, *Diversion, Snowmelt, Industrial wastes, Pulp and paper industry, Acidity, Acid streams, Volcanoes, Monitoring, Water pollution sources, *New Zealand, Whangaehu River.

Water quality along the Whangaehu River, New Zealand is affected by volcanic mud deposits and the input of industrial wastes at Tangiwai. Water quality in the winter months is generally good and improves with the onset of the warmer months, when tributaries contribute high quality waters from snowmelt. In 1979, 22 of the western tributaries of the Whangaehu River were diverted by the Western Diversion of the Tongariro Power Development Scheme to flow into the newly-created Moawhango Lake. Water rights were approved for the construction of the Kariori hydroelectric power scheme, which will divert water via canals from the Tokiahuru Stream into a storage lake, and then to the Whangaehu River. A continuous monitoring station was set up at Tangiwai to monitor water quality of the Whangaehu River after the Wahianoa Aqueduct Diversion projects were completed. Stainless steel housings were required for all monitoring instruments to protect the electrodes from the acidity of the water. Although a slower improvement in water quality now occurs below the Tokiahuru Stream confluence, little change to the quality normally measured prior to diversion was found in the central and lower river reaches. (Geiger-FRC)
W83-02449

5C. Effects Of Pollution

PHYCOLOGICAL STUDIES IN LAKES ONTARIO, ERIE, HURON, AND SUPERIOR,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 2H.
W83-02102

CHLORINATION OF ESTUARINE WATER: THE OCCURRENCE AND MAGNITUDE OF CARBON OXIDATION AND ITS IMPACT ON TRACE-METAL TRANSPORT,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
J. G. Sanders.
Environmental Science and Technology, Vol 16, No 11, p 791-796, November, 1982. 5 Fig, 7 Tab, 27 Ref.

Descriptors: *Chlorination, *Organic carbon, *Chelation, *Cooling water, Estuaries, Patuxent River, *Maryland, Oxidation, Copper, Trace metals, Fate of pollutants, Water pollution effects, Salinity, Chalk Point, Power plants, *Carbon oxidation.

Samples of estuarine water, salinity 0-10 o/oo, from Patuxent River, Chesapeake Bay, were chlorinated to levels of 0.05 to 10 mg per liter for periods of 1 to 30 days. Chlorination changed the original dissolved organic carbon (DOC) levels of 2.7-6.0 mg per liter and the composition of the mixture. This was monitored by loss of total DOC and changes in the molecular weight distribution of carbon. Losses of organic carbon varied from none to 50 micromol per liter (average 35), or 0 to 0.6 mg per liter. Carbon loss was not dependent on initial concentration of DOC or level of chlorination. Carbon loss occurred in all but one sample with salinities > 5 o/oo but not in any sample of lower salinity. In all samples chlorination also increased the percentage of lower molecular weight compounds due to degradation of macromolecules. 30% of the copper was associated with the < 1000 mol wt fraction and 70% with the $< 10{,}000$ mol wt fraction in both control and chlorinated samples. The quantity of carbon oxidized was small compared with the total complexation capacity of estuarine waters. Therefore, chlorination is not likely to cause shifts in metal speciation. However, coprecipitation with Mn and Fe oxyhydroxides was greater in chlorinated samples. Since a large portion of Patuxent River flow passes through the cooling system of the Chalk Point powerplant during low flow, it is estimated that organic carbon removal by chlorination could remove 11% of the river's DOC in an average year and 40% in an extreme low flow year. (Cassar-FRC)
W83-02104

EPIDEMIOLOGIC IMPACT OF WATER REUSE IN LOS ANGELES COUNTY,
California Univ., Los Angeles. School of Public Health.
For primary bibliographic entry see Field 3C.
W83-02105

ACID PRECIPITATION EFFECTS ON ALGAL PRODUCTIVITY AND BIOMASS IN ADIRONDACK MOUNTAIN LAKES,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
G. R. Hendrey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173203, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, December 1982. 8 p, 2 Tab, 11 Ref. OWRT A-078-NY(1), 14-34-0001-8034, 9034, 0134.

Descriptors: *Phytoplankton, *Acid precipitation, Primary production, Biomass.

Relationships between phytoplankton communities and lake acidity in three Adirondack Mountain Lakes were studied at Woods Lake (pH ca. 4.9), Sagamore Lake (pH ca. 5.5), and Panther Lake (pH ca. 7.0). Numbers of phytoplankton species observed were Woods 45, Sagamore 55, and Panther 85, conforming to observations at many other sites that species numbers decrease with increasing acidity. Peak Chl. a and productivity values, respectively, were Woods 6.8 mg m super -2 and 21 mg m super -2 hr super-1; Sagamore 12.2 mg m super -2 and 16 mg m super -2 hr super -1; and Panther 23 mg m super -2 and 52 mg m super -2 hr super -1. Patterns of increasing biomass and productivity in Woods Lake may be atypical of similar oligotrophic lakes in that they develop rather slowly to maxima six weeks after ice-out, instead of occurring very close to ice-out. Phytoplankton

productivity averaged from ice-out through July 31, 1979, were 12 mg m super -2 hr super -1, 10 mg m super -2 hr super -1, and 30 mg m super -2 hr super -1 for Woods, Sagamore, and Panther. Contributions of netplankton (net > 48 u m), nannoplankton (48 > nanno > 20 um) and ultraplankton (20 > ultra > 0.45 um) to productivity per m super -2 show that the smaller plankton are relatively more important in the more acid lakes, Woods > Sagamore > Panther (p. < .05). This pattern could be determined by nutrient availability (lake acidification is suspected of leading to decreased availability of phosphorus). The amount of 14 sub C-labelled dissolved photosynthate (14 sub C-DOM), as a percent of total productivity, is ordered Woods > Sagamore > Panther. This was consistent with a hypothesis that microbial heterotrophic activity is reduced with increasing acidity, but the smaller phytoplankton may be more 'leaky' at low pH. Analyses of stored samples for Total-P and zooplankton were curtailed due to lack of funds.
W83-02129

FOOD QUALITY OF AUFWUCHS FROM ARTIFICIAL STREAMS RECEIVING LOW LEVELS OF PERTURBATIONS,
Environmental Research Lab., Gulf Breeze, FL.
J. R. Clark, D. S. Cherry, and J. Cairns, Jr.
Water Resources Bulletin, Vol 18, No 5, p 761-767, October, 1982. 4 Tab, 42 Ref.

Descriptors: *Streams, *Food chains, *Sublethal effects, Water pollution effects, Copper, Chlorine, Glucose, Carbohydrates, Protein, Organic compounds, Algae, Aufwuchs, Periphyton, Species composition, *Cyanophyta, Heterotrophic bacteria, Bacteria.

Measurements of Aufwuchs food quality (protein, carbohydrates, and organic content) in artificial streams provided information on species abundance shifts as reactions to low level perturbations such as addition of chlorine, copper, and dextrose, at final concentrations of 0.2, 0.05, and 1-2 ppm, respectively. Protein content increased with increasing domination by blue-green algae or heterotrophs. Blue-green algae were numerous under copper or chlorine treatments and as water temperature approached the seasonal maximum, 22.8-25.8C. Heterotrophs were predominant in dextrose-enriched streams. Carbohydrate content of Aufwuchs was higher in the presence of blue-green algae or bacteria, but decreased under Cl or Cu treatments at low or moderate temperatures (3-22.8C), indicating utilization of stored photosynthetic products to adapt to the stress. The organic content of Aufwuchs was related to the extent of mucilage produced and the tendency of the community to accumulate detritus and suspended sediments. The food quality of Aufwuchs is important in evaluating the impact of pollutants on grazers and higher trophic levels. (Cassar-FRC)
W83-02148

WATER RESOURCES AND HUMAN HEALTH: THE VIEWPOINT OF MEDICAL GEOGRAPHY,
Hunter Coll., New York. Dept. of Geology and Geography.
A. Van Burkalow.
Water Resources Bulletin, Vol 18, No 5, p 869-874, October, 1982. 40 Ref.

Descriptors: *Public health, *Diseases, *Geography, Human diseases, Medical geography, Water resources development, Water pollution effects, Trace elements, Hot springs, Mineral springs, Springs, Fluorine, Lithium, Pathogens, Waste disposal, Recreation, Irrigation, Transportation.

Medical geography is concerned with areal patterns of human health and disease and the contributing environmental and cultural factors. Water resources are an important aspect of these studies for several reasons: they are essential to life, provide beauty and inspiration, and are partially responsible for more than 80% of all disease. Inorganic factors in human health and disease associated with ground and surface waters include minerals dissolved in water (hot springs, fluorine as related to teeth, lithium as a mood stabilizer, iodine in goiter treatment and prevention, and water hardness as related to cardiovascular disease). Organic factors include pathogens (bacteria, viruses, fungi, worms, etc.), nonhuman hosts such as snails carrying schistosomiasis, and vectors such as mosquitoes. The cultural environment can cause and spread human disease through pollution by municipal, agricultural, and industrial wastes; religious practices (bathing in the polluted Ganges River or traveling to religious shrines); recreation (crowding in resort areas and swimming in polluted waters); building reservoirs and irrigation projects (schistosomiasis and mosquito-borne diseases); transportation (highway deicers and lead from gasoline); and water softening. Cultrual practices also protect against waterborne diseases: insect control, drinking water protection and treatment, trace element removal or addition, and vaccinations. (Cassar-FRC)
W83-02168

THE ROLE OF GIZZARD SHAD (DOROSOMA CEPEDIANUM) IN EUTROPHIC FLORIDA LAKES,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 2H.
W83-02184

SEDIMENT TOXICITY AND THE DISTRIBUTION OF AMPHIPODS IN COMMENCEMENT BAY, WASHINGTON, USA,
Corvallis Environmental Research Lab., OR.
R. C. Swartz, W. A. Deben, K. A. Sercu, and J. O. Lamberson.
Marine Pollution Bulletin, Vol 13, No 10, p 359-364, October, 1982. 3 Fig, 4 Tab, 10 Ref.

Descriptors: *Sediments, *Bays, *Hazardous materials, Waste disposal, Hazardous waste, *Toxicity, Environmental effects, Commencement Bay, *Amphipods, Water quality, *Washington, Puget sound.

Commencement Bay of Puget Sound, Washington, has long received hazardous wastes containing organic and inorganic toxic materials from a variety of industrial sources. The toxicity of 175 sediment samples from Commencement Bay was measured by the survival of marine infaunal amphipods (Rhepoxynius abronius) during ten day exposure to the test sediment. Survival was high in sediment from offshore, deeper parts of the Bay, including two designated dredge material disposal sites. Within each of the major industrialized waterways there was a wide range in amphipod survival. Both acutely toxic and relatively nontoxic samples were collected from various areas within the Hylebos, Blair, Sitcum and City Waterways. Habitat differences, sedimentation rates, proximity to contaminant sources and sinks, and disruption of the seabed by prop scour and dredging could contribute to this variation in toxicity. Community structure data show a correlation between amphipod distribution and sediment toxicity, with lower amphipod density and species richness in the waterways than in the deeper part of the Bay. Phoxocephalid amphipods, a family that includes the bioassay species, were ubiquitous in the deeper Bay, but absent from the waterways. This correlation between laboratory and field results indicates the ecological relevance of the sediment bioassay. (Baker-FRC)
W83-02204

A LABORATORY/FIELD INVESTIGATION INTO THE BIOLOGICAL EFFECTS OF URBAN RUNOFF,
Massachusetts Univ., Amherst. Water Resources Research Center.
C. Medeiros, and R. A. Coler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177956, Price codes: A05 in paper copy, A01 in microfiche. Publication No 130, July 1982. 65 p, 20 Tab, 11 Fig, 69 Ref. OWRT A-126-MASS(1), 14-34-0001-9023.

Descriptors: *Urban runoff, *Fish toxins, *Toxicity, Water quality, Macroinvertebrates, *Heavy metals, Fathead minnows, Brook trout, Black Nose Dove, *Massachusetts, Greenfield, Green River, *Lethal limit.

The effects of urban runoff on the hatchability, survival and growth of Pimephales promelas was assessed in the laboratory using flow-through (proportional diluter) and static (38.1 aquaria) systems. In the field, urban runoff was assessed using artificial substrates/live traps to derive diversity, survival, and metal accumulation values. To correlate toxicity with water quality, chemical analyses were performed on water, suspended solids, and sediments at 2 river stations and 2 runoff input sources. Results showed a large variability in runoff chemistry between seasons and even within the same storm. The long term toxicity tests with the fathead minnow showed growth to be limited to 50% of control values at approximately 60% of full strength. The maximum allowable toxicant concentration (MATC), on the other hand, was approximately 28%. Hatchability and average length as indicators of stress, were not as sensitive as millimeters produced per treatment and maximum and minimum sizes. The field studies largely confirmed the laboratory chronic studies. Significant differences in survival, diversity, and heavy metal accumulation did not occur until snow melting or rain events occurred. During such periods, diversity values approached one half those of the controls, and heavy metal content was 2 to 10 times control levels.
W83-02210

A SURVEY OF SEDIMENT DISCHARGE AND SHELF REEF CONDITIONS,
Puerto Rico Univ., Mayaguez. Dept. of Marine Sciences.
J. Morelock.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178012, Price codes: A03 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Mayaguez, 1983. 34 p, 10 Fig, 3 Tab, 10 Ref. OWRT A-059-PR(1), 14-34-0001-1141.

Descriptors: *Sediment discharge, *Coral, *Reefs, Carbonate rocks, *Puerto Rico, Zonation, *Marine sediments.

Coral can tolerate turbid conditions and sediment stress to some extent. The zonation of the reef is, however, dependent on light intensities and the corals have different susceptibilities to direct sediment cover. It has been found that Acropora palmata was the most sensitive to application of silty sediments in field conditions and that Agaricia agaricites, Porites asteroides, and Acropora cervicornis had lower net productivity after application of silt than other corals. This explains in part that the depth zonation not only changes upward from an increase in turbid water, but the new assemblage is missing some of the deeper water corals and there has been a change in the abundances and dominant species not explained by a simple response to light loss. The environments of Mayaguez, Anasco and Guayanilla Bays were once favorable to coral development. This is attested to by fairly large, well developed reef tracts in all of these areas. At the present time, more than 50% of the original reef is no longer living and there is no evidence of regeneration or development of new reef areas. There does appear to be a continuous record of loss of total reef area which is likely to continue. (Munoz, Puerto Rico)
W83-02216

BACTERICIDAL SERUM RESPONSE OF THE CHANNEL CATFISH AGAINST GRAM-NEGATIVE BACTERIA,
Memphis State Univ., TN. Dept. of Biology.
D. D. Ourth, and E. A. Wilson.
Developmental and Comparative Immunology, Vol 6, 1982. p 579-583, 1 Tab, 10 Ref. OWRT A-057-TN(2), 14-34-0001-9045.

Descriptors: *Catfish, *Fish diseases, *Fish farming, Fish, *Viruses, *Bacteria, *Fish toxins, Immunity, Water pollution effects.

The purpose of this investigation was to determine if fresh channel catfish serum from unimmunized catfish is bacterial against 14 different Gram-Negative and Gram-Positive bacteria. The objective was to see if serum from the unimmunized catfish is bactericidal to these different bacterial species and how great the percentage of bactericidal activity may be as the percentage could vary among bacterial species. If a low percentage of bactericidal activity by fresh catfish serum is found against a Gram-Negative pathogen, then that could be an important reason why it is a successful fish pathogen. The channel catfish (Ictalurus punctatus), a teleost fish, is extensively used in aquaculture in Southeast U.S.A. It therefore becomes important to study what role catfish serum performs in bactericidal action and thus immunity against bacterial fish infections and diseases.
W83-02219

ALTERNATE PATHWAY OF COMPLEMENT AND BACTERICIDAL RESPONSE OF THE CHANNEL CATFISH TO SALMONELLA PARATYPHI,
Memphis State Univ., TN. Dept. of Biology.
D. D. Ourth, and E. A. Wilson.
-34-0001-9045.

Descriptors: *Catfish, *Bacteria, *Salmonella, Fish, Viruses, *Fish diseases, *Fish Toxins, Serum, Immunity, Antitoxins, Water pollution effects.

Fresh Channel Catfish (Ictalurus punctatus) serum from unimmunized catfish exhibited 100% bactericidal activity against Salmonella paratyphi. Components responsible for bactericidal activity could be absorbed from the fresh catfish serum with S. paratyphi. The bactericidal system of the fresh catfish serum showed a need for magnesium rather than for calcium after EDTA treatment. The additions of salicylaldoxime or ammonium hydroxide to catfish serum indicated the alternate rather than the classical pathway of complement activation to be important in bactercidal activity against S. paratyphi. Bactericidal activity of catfish serum was labile when incubated at 47C for 30 min., stable for at least 4 mo. at -80C and could be absorbed with S. paratyphi at 25C. Very minimal bactericidal activity was present in the descending portion of the first 13.7S peak with most activity being found in the descending portion of the second 7.1S peak and throughout the entire 3.4S peak after Sephadex G-200 catfish serum fractionation.
W83-02220

NEUTRALIZATION OF BACTERIAL EXOTOXIN (TETANUS TOXIN) BY CHANNEL CATFISH IGM ANTIBODY,
Memphis State Univ., TN. Dept. of Biology.
D. D. Ourth.
Immunology, Vol 45, 1982. p 49-53, 1 Fig, 2 Tab, 15 Ref. OWRT A-057-TN(3), 14-34-0001-9045.

Descriptors: Fish, Viruses, *Bacteria, *Fish diseases, *Fish toxins, *Catfish, Tetanus, Immunity, Serum, Antitoxins, Water pollution effects.

A bacterial exotoxin neutralization response by fish IgM antibody has not been demonstrated previously in any fish species. Channel catfish, Ictalurus punctatus, were immunized intraperitoneally with alum-absorbed tetanus toxoid. Catfish immune serum demonstrated 1.28 antitoxin units (a.u.) of antitoxin neutralization and gave an indirect haemagglutination (IHA) titre of 1:65, 536. After 2-mercaptoethanol (2ME) reduction of immune serum, no antitoxin neutralization remained but an IHA serum titre of 1:4096 was present. After Sephadex G-200 gel filtration of the catfish immune serum, the 14S antibody gave 0.32 a.u./ml and an IHA titre of 1:256. The 7S antibody gave no antitoxin neutralization but an IHA titre of 1:512 was found. After 2ME reduction, neither the 14S or 7S globulins demonstrated antitoxin neutralization, but minimal IHA titres of 1:16 and 1:4, respectively, were still found. The catfish immune serum and the 14S and 7S globulins did not precipitate tetanus toxoid by immunodiffusion in 1% agar gel.
W83-02221

THE ECOLOGICAL EFFECTS OF PULP LOG SALVAGE ON FISH COMMUNITIES IN A RESERVOIR,
Maine Univ. at Orono.
M. T. Negus.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178079, Price codes: A05 in paper copy, A01 in microfiche. M.S. Thesis, August 1982. 86 p, 14 Fig, 3 Tab, 96 Ref. University of Maine at Orono. OWRT B-020-ME(2), 14-34-0001-0226.

Descriptors: Fish diets, Fish food organisms, Fish migration, Fish populations, Fisheries, *Logging, *Ecological effects, Water pollution effects, *Maine, Kennebec River, Wyman Lake, Reservoirs, Yellow perch, Golden Shiners.

One hundred forty years of log driving in the Kennebec River left an estimated one to two million cores of spruce and fir pulpwood logs submerged in Wyman Lake. Commercial salvaging of these logs from 1979-81 prompted a study to assess the importance of these logs to fishes, and the effects of log salvaging on fishes. Techniques employed in this study were vertical gill netting, radio tracking, and stomach content analysis. The vertical distribution of the various fish species in the water column and the horizontal distribution of fishes in different parts of the lake indicate some habitat segregation by fish species. Yellow perch (Perca flavescens) were significantly more numerous in sites without logs, and numbers of suckers (Catostomus spp.), golden shiners (Notemigonus crysoleucas), chain pickerel (Esox niger), and pumpkinseed (Lepomis gibbosus) were significantly higher in sites with logs. Yellow perch were usually captured near the lake bottom, and most other species tended to be distributed higher in the water column. The relationships of these distributions to the presence of logs are questionable. Radio tracking data indicate yellow perch tend to concentrate movements near a home area, but movements may range widely. Yellow perch preyed more heavily on cladocerans in sites without logs, and on larger invertebrates in sites with logs. These differences in food habitats could reflect different prey availability due to physical variations between study areas. However, coefficients of condition of yellow perch and common shiners were significantly higher in areas without logs. Moderate log salvage operations would probally have little impact on the fishes of Wyman Lake, if certain precautions were taken.
W83-02227

BIOLOGICAL INDICATION OF WATER QUALITY: THE GEOGRAPHIC ASPECT,
All-Union Scientific-Industrial Association of the Pulp and Paper Industry, Moscow (USSR).
For primary bibliographic entry see Field 5A.
W83-02236

CHANGE IN THE SYSTEM OF CARBON COMPOUNDS IN LAKES UNDER THE EFFECT OF HUMAN ACTIVITIES,
Akademiya Nauk SSSR, Leningrad. Inst. Ozerovedeniya.
E. A. Rumyantsev.
Water Resources (English Translation), Vol 8, No 6, p 660-665, November/December, 1981. 1 Fig, 4 Tab, 6 Ref. Translated from Vodnye Resursy, No 6, p 152-158, November/December, 1981.

Descriptors: *Lakes, *Eutrophication, *Water pollution sources, Industrial waste, Dairy wastes, Farm wastes, Carbon, Organic compounds, Water pollution effects, Water quality, *USSR, Estonia, Latvia.

Water quality of lakes undergoing a natural evolutionary process was compared to that in lakes which had been disturbed by anthropogenic influences. In order to study the most common properties of the system of carbon compounds and its transformation under the effect of human activity, all the compounds were reduced to functionally different groups: carbon of mineral compounds, carbon of dissolved organic materials, and carbon of suspended organic materials. The eutrophic lakes included in the study were contaminated by the wastewaters of a dairy, the use of the drainage basin for plowland, and the retting of flax. The waters of lakes influenced by man's activities had a significantly higher total carbon content. (Baker-FRC)
W83-02248

HYDROBIOLOGICAL EVALUATION OF WATER QUALITY OF A MULTIPURPOSE RESERVOIR SUBJECTED TO THE EFFECT OF INDUSTRIAL WASTEWATERS,
Dnepropetrovskii Gosudarstvennyi Univ. (USSR).
Yu. K. Gaidash, A. K. Dyga, and V. I. Zolotareva.
Water Resources (English Translation), Vol 8, No 6, p 655-660, November/December, 1981. 2 Tab, 9 Ref. Translated from Vodnye Resursy, No 6, p 145-151, November/December, 1981.

Descriptors: *Water quality, *Reservoirs, *Water pollution effects, Industrial wastes, Wastewater disposal, Environmental effects, Indicator organisms.

The regularities of formation of the fanual complexes of plankton and macrobenthos, structure of zoocenoses, and degree of alterations of the biofilter, consisting of benthic organisms, were examined under conditions of a regulated streamflow in the case of inflow of pollutant into a reservoir typical for the southern slope of the country from its drainage area and with the wastewaters of industrial enterprises. The following biological criteria were used to assess the level of pollution: species composition, their number and biomass, presence of indicator organisms, and structure of communities. Plankton and benthic communities at sites of distribution of wastewaters continue to exist and function as an integral system, but the pressure of pollution is so powerful that the communities of organisms cannot cope with the pollutants being introduced in the upper and, to some extent, the middle stretches of the reservoir under study. It is concluded that it is necessary to use the most radical means for protecting multipurpose reservoirs under conditions of a strong anthropogenic impact on them, even to the extent of converting the industrial enterprises to a zero-discharge water supply system. (Baker-FRC)
W83-02250

SURVEY, ECOLOGY, AND SYSTEMATICS OF THE UPPER POTOMAS ESTUARY BIOTA: AUFWUCHS MICROFAUNA - PHASE III,
Georgetown Univ., Washington, DC. Dept. of Biology.
D. M. Spoon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-180281, Price codes: A02 in paper copy, A01 in microfiche. D. C. Water Resouces Research Center Report No 39, Univ. of the District of Columbia, July 1982. 35 p, 2 Fig, 15 Ref, 2 Append.

Descriptors: Bench scale models, Continuous flow system, *Organic pollution, Thermal pollution, Anabaena, Cladocerans, Daphnia, Ostracods, Copepods, Algal Blooms, Eutrophication, *Cyanophyta, Potomac River estuary, *Periphyton, District of Columbia, Zooplankton.

These studies utilized two adjacent bench scale rivers, each composed of four interconnected 24-gallon aquaria, stimulating summer flow and temperature (30 degrees C) of the fresh water estuarine Potomac River from Hains Point to Piscataway Creek. Initially all eight aquaria were seeded with the filamentous blue-green alga, Anabaena. To all aquaria was added a mixture of Daphnia, copepods, and ostracods from a swamp near Little Falls. (Preliminary studies showed these zooplankters could remove the Anabaena.) The experimental side received activated sludge from the Blue Plains Sewage Treatment Plant, while the control received dechlorinated tap water. Temperature, D.O., pH, phosphate, nitrate, and transmittance were determined. In experiment I, we obtained a pronounced algal bloom on the experimental side over the ten day run with reduction of zooplankters and their grazing. In experiment II, with sewage added to both sides, we used a heat shock of 10 degrees C in a bypass simulating the

conventional power plant on the experimental side causing decreased zooplankters and increased algal growth.
W83-02291

TOXAPHENE,
California State Water Resources Control Board, Sacramento.
For primary bibliographic entry see Field 5B.
W83-02299

CALIFORNIA STATE MUSSEL WATCH: 1980-81, TRACE METALS AND SYNTHETIC ORGANIC COMPOUNDS IN MUSSELS FROM CALIFORNIA'S COAST, BAYS, AND ESTUARIES,
California State Dept. of Fish and Game, Monterey. Marine Bioassay Lab.
S. L. Coale, D. Smith, E. Armbrust, M. D. Stephenson, and M. Martin.
Water Quality Monitoring Report 81-11-TS, California State Water Resources Control Board, Sacramento, May 1982. 177 p, 104 Fig, 31 Tab, 89 Ref, 15 Append.

Descriptors: *Mussels, *Minerals, *Water quality, *Marine animals, Outfall sewers, Marine environment, Environmental effects, Water pollution effects, Marine biology, Water pollution sources, Ocean dumping, Water sampling, Organic compounds, Trace elements, Harbors, Bays, Coastal waters.

Since 1977 the State Mussel Watch (SMW) has monitored the accumulation of trace metal and synthetic organic compounds in marine mussels since they are good indicators of spacial and temporal distributions of toxicants. Part I of this report gives an overview of statewide conditions and a regionalized summary of the 1980-81 results. Silver, lead, zinc, PCBs and DDE were selected for comparison. Part II provides additional information on long-term trends of trace metals using baseline data from prior studies. The metals analyzed in mussel tissues included silver, aluminum, arsenic, cadmium, chromium, copper, mercury, manganese, lead, selenium and zinc. Mussels were transplanted to two open coast stations and 34 bay station during two time intervals. Aluminum, cadmium, copper, chromium, manganese, mercury and zinc appear to be detrimental to mussel reproduction as measured by the gonad index. Based on correlation analyses, aluminum, cadmium, copper, chromium, manganese, lead and zinc are suspected of having adverse affects on incremental growth. Part III is a follow-on analysis to the 1979 survey of synthetic organic compounds in mussels which showed substantial amounts of DDT compounds, PCBs, chlordane, dieldrin, heptachlor and endosulfan in certain areas. The 1980 study included intensive site surveys in San Francisco Bay, Los Angeles-Long Beach Harbor and San Diego Bay where higher trace metals and synthetic organic compounds had previously been measured. PCBs, dieldrin and endosulfan levels were about the same as in 1979. Chlordane levels were generally higher in urban areas. There is a greatly reduced rate of loss of DDT compounds as compared to the rate of decline in the early 1970s. (Atkins-Omniplan)
W83-02300

THE KELP FORESTS OF PALOS VERDES PENINSULA 1982,
California State Dept. of Fish and Game, Sacramento.
K. Wilson.
In: Coastal Water Research Project, Biennial Report for the years 1981-1982, Southern California Coastal Water Research Project, Long Beach, CA., Willard Bascom, ed. p 67-70, 2 Fig, 11 Ref.

Descriptors: *Kelps, *Suspended solids, *Wastewater treatment, *Echinoderms, Sedimentation, Commerical fishing, Light penetration, Substrates, Secondary wastewater treatment.

The forests of giant kelp off Palos Verdes Peninsula provide food and shelter for many fish and invertebrates; however, the condition and size of the forests has fluctuated widely. In the mid-forties the forests began to deteriorate and by 1954 commercial harvesting was no longer feasible. In 1974 the kelp forests and associated biotic communities began to recover and approximately 700 acres existed by 1982, although this is much lower than the 1,800 acres measured in 1928. Solids in Los Angeles County's wastewater discharges contributed substantially to the decline and loss of kelp forests off the peninsula. Pinpointing which effects of the solids are the worst offenders is difficult. Among those suggested are: the siltation and burial of rocky surfaces by floc originating from plankton; reduction in depth of euphotic zone by suspended materials; high concentration of toxic chemicals; warm ocean temperatures from 1957 to 1959; and over grazing by sea urchins. Improved sewage treatment facilities since 1971 greatly reduced the discharge of suspended solids. Environmental changes improved the quality and quantity of light available for kelp growth and diminished substrate burial. Commercial harvesting of red sea urchins helped spur the return of kelp forests; however, unless purple and white sea urchins are harvested as well, restoration of the beds will remain unstable. Modern treatment facilities and techniques have reduced suspended solids levels to that of 1956. A high-intensity kelp restoration program along with continued improvements in sewage treatment facilities will do much to enhance the kelp forest habitat and associated marine resources. (Atkins-Omniplan)
W83-02304

SANTA MONICA BAY PLANKTON DISTRIBUTION,
University of Southern California, Los Angeles. Allan Hancock Foundation.
G. Kleppel, E. Manzanilla, B. Teter, and S. Petrich.
In: Coastal Water Research Project, Biennial Report for the years 1981-1982, Southern California Coastal Water Research Project, Long Beach, CA., Williard Bascom, ed. p 71-84, 9 Fig, 1 Tab, 13 Ref.

Descriptors: *Phytoplankton, *Zooplankton, *Nitrogen, *Nitrates, *Wastewater disposal, *Ammonium, Outfall sewers, Water sampling, Ocean circulation, Euphotic zone, Vertical distribution, Advection, Distribution patterns, Flourescence.

Phytoplankton can be indicative of eutrophication and contamination in estuaries, but is less definitive in open coastal waters. The author's objectives were to determine of phytoplankton abundance and composition near the Hyperion 5-mile outfall differed from that along an onshore-offshore transect in the bay, and to determine if plankton and nutrient distributions were influenced by wastewater discharge. During 1980, monthly samples were taken at nine stations. The results suggest that several nitrogen sources drive phytoplankton growth and distribution in the bay. Nitrate enters the euphotic zone by vertical diffusion and possibly by horizontal advection from the Santa Barbara Channel. Ammonium in the bay may be from discharge from marinas, nearshore outfalls, or recycling by animals and bacteria. Not surprisingly, nitrate and ammonium levels were usually higher near the bottom of the euphotic zone than at the surface, suggesting that light intensity could influence phytoplankton growth. Nitrogen from the 5-mile Hyperion outfall was rarely detectable in the euphotic zone. Nothing unusual was detected in net phytoplankton abundance, distribution, or composition in the outfall's vicinity. Zooplankton abundance at the outfall station was higher than elsewhere along the transect but defining the process (growth, entrainment, migration) reponsible was nearly impossible. Several hypotheses need to be tested regarding the cause of the peak, i.e., that waste discharge causes an elevation in primary production which is grazed down by the zooplankton, and/or that zooplankton feed on materials in the wastefield directly. (Atkins-Omniplan)
W83-02305

AN ADVANCED SEDIMENT-QUALITY MODEL,
Southern California Coastal Water Research Project Authority, Long Beach.
T. Hendricks.
In: Coastal Water Research Project, Biennial Report for the years 1981-1982, Willard Bascom, ed. p 247-257, 6 Fig.

Descriptors: *Model studies, *Municipal wastewater, *Outfall, *Sedimentation rates, *Coastal waters, Marine sediments, Suspension, Bathymetry, Distribution patterns, Benthic environment, Effluents, Particulate matter, Water depth, Current meters.

To estimate the effects of a new outfall, or to estimate changes as a result of modified treatment, a numerical model was developed to simulate the processes which determine the properties of the sediments. A sedimentation sub-model estimated the sedimentation fluxes and patterns in both the Palos Verdes and Newport Beach outfall areas. Hypothetical outfalls, of identical design and wastewater characteristics, were created at both sites to see if either could better minimize the effects on the benthos. The sedimentation rate around Newport Beach would be about half that off of the Palos Verdes. However, since the currents are different at each site, it is not clear whether the differences are due to bathymetric variations or to differences in currents, but the results suggest that slightly more than half of the increased flux of particulates in the Palos Verdes area is related to the bathymetry, with the remainder associated with currents. Other processes included in the model are the sedimentation of natural particulates, resuspension and redistribution of sediments, bioturbation, and simple forms of biological decompositon and chemical mobilization of trace consitituents in the sediments. The first three parameters will be determined by comparing the predicted charcteristics of the sediments in the Palos Verdes area with observed characteristics in cores from a joint Los Angeles County and SCCWP Study. Further model testing will compare predicted and observed characteristics at 3 or 4 other outfall sites and the results described in a future report. These sites cover a wide range of suspended solids mass emission rates. The outfalls discharge in water depths of 20 to 56 meters. (Atkins-Omniplan)
W83-02308

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES III HARTENBOS, LITTLE BRAK AND GREAT BRAK RIVERS (MOSSEL BAY),
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W83-02376

INDIA'S WATER BORNE DISEASES--A CHALLENGE,
Minor Irrigation Dept., Lucknow (India).
A. C. Chaturvedi.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 62, No 2, p 37-42, February, 1982. 1 Tab, 14 Ref.

Descriptors: *Diseases, *Public health, *Developing countries, Human diseases, *India, Water pollution effects, Bacteria, Water supply, Research priorities.

The widespread incidence of waterborne disease in India is a result of contamination of water supplies with infectious agents and excessive quantities of inorganic ions. Studies have indicated that increased water hardness promoted human health and that Himalayan peoples drinking pure mountain water had a lower cancer mortality rate than persons drinking polluted waters. Cholera, olter stram, hepatitis, parasitic diseases, and other health problems affect a large proportion of the population and retard national progress. Of Bombay's 7 million inhabitants, half have suffered clinical or sub-clinical jaundice. The problems of rural water supplies are as yet undefined. No long range plans, finances, or institutional framework exist to study the problems. Most development of water testing equipment has been concentrated in cities. There is a great need to develop simple testing and treatment units for the rural areas, for training programs, and for epidemiological studies. (Cassar-FRC)
W83-02386

THE EFFECT OF ENVIRONMENTAL FACTORS ON THE SUSPENDED BACTERIA IN THE WELSH RIVER DEE,
Liverpool Polytechnic (England). Dept. of Biology.
D. Nuttall.
Journal of Applied Bacteriology, Vol 53, No 1, p 61-71, 1982. 5 Tab, 22 Ref.

Descriptors: *Bacteria, *Organic matter, *Temperature, *Heterotrophic bacteria, Dee River, *Wales, Water temperature, River flow, Particulate matter, Multivariate analysis, Water quality, *Regression analysis, Rivers, Sampling, Data collections.

Water samples collected every 8 days from 3 sites (upper, middle, and lowland) on the Welsh River Dee during 1975-76 were analyzed for physical, chemical, and biological variables and heterotrophic bacteria activity. Bacterial population estimates were regressed on 21 independent environmental variables using multiple linear regression analysis. Prediction equations calculated for the 1975-76 data accounted for 70% of the total variation for the upland site and 40% for the lowland site. Data from 1977-78 were used to examine the validity of the 1975-76 data. Correlations of bacterial plate count values were significant for the upper and middle reaches but not for the lowland reach. The direct count correlation was significant for all 3 sites. Permanganate value, a measure of organic matter, was the most dominant variable and was shown by principal component analysis to be linked to particulate matter and river flow. The logarithm of the heterotrophic potential for the lowland site was a linear function of temperature. A specific activity index calculated for the lowland site data gave a median value of 8.4 times 10 to the minus 10th power micrograms per hour per bacterial cell; it was highly sensitive to temperature change. The upland site specific activity index was 2.6 times 10 to the minus 10th power micrograms per hour per bacterial cell and did not respond significantly to temperature change. (Cassar-FRC)
W83-02402

SOME EFFECTS OF VOLCANIC ASH ON PLANKTON PRODUCTIVITY,
Washington State Univ., Pullman. Dept. of Zoology.
R. A. Parker, and A. J. Gaddy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187179, Price codes: A02 in paper copy, A01 in microfiche. Washington Water Research Center Completion Report, Washington State Univ., Pullman, February 1983. 19 p, 13 Tab, 20 Ref. OWRT C-10049(1441)(1).

Descriptors: Photosynthetic, *Ash, Carbon-14, Carbon, *Zooplankters, Grazing activity, *Planton productivity, *Washington, Mt. St. Helens, *Cyclotella, *Cryptomonas, *Diaptomus, *Daphnia, Water pollution effects.

Experiments were conducted to determine the effects of soluble and particulate fractions of Mt. St. Helens ash on carbon-14 uptake by Cyclotella and Cryptomonas. Cyclotella demonstrated reduced photosynthetic activity in the presence of filtrate, and ash suspensions increased carbon fixation by Cryptomonas. In addition, the effects of particulate ash on feeding and assimilation by Diaptomus and Daphnia were measured. When fed Cryptomonas together with ash, grazing activity by both zooplankters was not affected. On the other hand, when fed Cyclotella with small amounts of ash, Daphnia ingested more algae whereas Diaptomus did not. Also, ash interfered with the assimilation of carbon-14 by Daphnia from ingested Cyclotella.
W83-02410

MICROBIAL UPTAKE OF CADMIUM AND ITS EFFECTS ON THE BIOCHEMICAL OXYGEN DEMAND AT VARIOUS TEMPERATURES,
Aligarh Muslim Univ. (India). Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W83-02414

5D. Waste Treatment Processes

PHOTOCATALYTIC OXIDATION OF ORGANIC POLLUTANTS,
Delaware Univ., Newark. Dept. of Chemical Engineering.
G. L. Schrader, and M . M. Hwang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173179, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Center Completion Report, Univ. of Delaware, Newark, December 1982. 27 p, 8 Fig, 3 Tab. OWRT A-042-DEL(2), 14-34-0001-9008.

Descriptors: Industrial wastes, *Photooxidation, *Wastewater oxidation, *Phenols, *Catalysts, *Wastewater treatment, Stream pollution, *Organic acids, *Organic wastes.

The photooxidation of phenol in aqueous solution with several catalysts was studied in a batch-recycle reactor at 65C and atmospheric pressure. The tubular reactor was irradiated with a polychromatic ultraviolet lamp located at a focus of an elliptical reflector. Different metal nitrate salts were used as catalysts, including nickel nitrate, cobalt nitrate, ferric nitrate, manganese nitrate, cerium nitrate and lanthanum nitrate. Liquid samples from the photoreactor were analyzed by gas chromatography for phenol concentration. The presence of cations of catalysts were determined by ultraviolet spectroscopy. The ferric nitrate was the most active catalyst. The initial rate of phenol decomposition was in first order with respect to phenol concentration for all catalysts.
W83-02126

UTILIZATION OF MOLECULAR OXYGEN AND SUNLIGHT IN THE OXIDATIVE PURIFICATION OF WATER,
West Virginia Univ., Morgantown. Water Research Inst.
W. R. Cherry, and B. P. Jessen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173252, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, 1982. 16 p, 4 Fig, 5 Tab, 15 Ref. OWRT A-042-WVA(1), 14-34-0001-1152.

Descriptors: *Chlorinated hydrocarbons, *Irradiation, *Oxidation, *Photoactivation, *Solar radiation, *Wastewater treatment, *Water treatment, Catalysts, Chemical degradation, Industrial wastes, Organic compounds, Oxygen, Phenols, Photosynthesis, Pollutants, Polymers.

The study was directed toward obtaining knowledge that could be used in developing new, better, and less costly methods for treating wastewater and drinking water without producing harmful substances. Oxidation of several chlorinated phenols by singlet oxygen was investigated. The two main products resulting from the oxidation of orthochlorophenol were isolated and characterized. The kinetics for the oxidation of ortho-, meta-, and parachlorophenol were determined in methanol and in water. Pentachlorophenol was oxidized in the same way as the monochlorophenols. Rose bengal was used as the sensitizer. The sensitizer was bound to hydrophilic-polymer beads to prevent the dye from contaminating the water. The method is very effective in oxidizing chlorinated phenols. The aromatic ring is destroyed and the chlorine becomes an inorganic chloride ion. The rates are practical for treatment even at the low concentrations of chlorinated phenols commonly contained in polluted water-supply sources. The rate for pentachlorophenol is faster than those for the monochlorophenols. Pentachlorophenol was completely decomposed in three hours. The process is satisfactory as a basis for research and development of a new wastewater and water-supply treatment method.
W83-02134

PERMITTING OPTIONS AND DESIGN PROCEDURE FOR A CONTROLLED-DISCHARGE WASTEWATER TREATMENT FACILITY,
Georgia Univ., Athens. Inst. of Natural Resources.
K. J. Hatcher.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175265, Price codes: A07 in paper copy, A01 in microfiche. Environmental Resources Center Report No ERC 06-82, Atlanta Georgia Institute of Technology, August 1982. 120 p, 9 Fig, 11 Tab, 24 Ref. OWRT A-087-GA(1), 14-34-0001-0111.

Descriptors: *Wastewater treatment, Discharge permits, Water quality, *Mathematical models, Cost minimization, *Oxidation, Oxidation pond, Lagoons, Effluent, Effluent storage, *Land application, Facilities, Facility upgrading, Computers, Computer software, *Risks, Wastewater treatment plants.

A wastewater treatment facility with a controllable discharge rate can meet stringent stream quality standards at a lower treatment cost than a conventional facility. This research project examines permitting and design procedures for a controlled-discharge treatment facility, which has a wastewater storage pond and/or land application site added to a conventional primary or secondary treatment facility. The facility's discharge rate to the receiving stream is controlled to match the stream's daily or seasonal flow and waste assimilative capacity, and the discharge rate to the land application site (if one is used) is also controlled. To realize any cost savings, a controlled-discharge facility requires a new type of 'hydrograph-controlled' discharge permit to allow the facility to discharge a higher waste load during higher streamflow periods. Since the usual '7-day, 10 year' minimum stream flow condition can't be used in determining waste load limitations for a hydrograph-controlled permit, risk-based permit criteria are proposed for different design drought hydrographs. Four types of hydrograph-controlled permit criteria are described and evaluated in terms of treatment cost savings, stream quality protection, and 'ease of use' as compared to a conventional permit for a constant discharge facility. This report develops a generalized facility simulation model and an optimization method for quickly determining the least cost facility design and discharge schedule.
W83-02181

ANAEROBIC TREATMENT OF PULP AND PAPER WASTES,
ADI Ltd., Fredericton (New Brunswick).
A. A. Cocci, R. C. Landine, T. Viraraghavan, and G. J. Brown.
Pulp and Paper Canada, Vol 83, No 9, p 70-73, September, 1982. 2 Fig, 2 Tab, 18 Ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Pulp and paper industry, *Pulp wastes, Industrial wastes, White water, Kraft mills, Sulfite liquors, Anaerobic conditions, Financial aspects.

The use of anaerobic treatment of pulp and paper wastes in most situations can offer decided capital and operating cost savings when compared to an aerobic system of equivalent design. The theory of anaerobic treatment and trends in the field are reviewed, along with several of the anaerobic treatment processes available. The major advantages of anaerobic treatment are identified, and the results from laboratory, pilot and full-scale anaerobic systems treating a number of different pulp and paper waste streams are summarized. (Baker-FRC)
W83-02189

PACKED-BED REACTORS FOR CONCENTRATED-WASTE TREATMENT AND ENERGY PRODUCTION,
Puerto Rico Univ., Mayaguez. Dept. of Mechanical Engineering.
K. B. Pedersen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177998, Price codes: A06 in paper copy, A01 in microfiche. Puerto Rico Waters Resources Research Institute Completion Report, Mayaguez, 1983. 97 p, 19 Fig, 13 Tab, 46 Ref, 1 Append. OWRT A-052-PR(1), 14-34-0001-9041.

Descriptors: *Anaerobic digestion, *Digestion equipment, Domestic wastes, Organic loading, Methane bacteria, *Puerto Rico, *Wastewater treatment, Energy production, Filter processes.

The objective of this research project was to study the design parameters of the anaerobic filter process such as organic loadings and hydraulic retention time, and the response of the process in relation to organic matter removal and energy production for a typical condition in Puerto Rico. The organic loading was found to be a very important parameter during the operation of the anaerobic filter. The activity of the filter in removing organic matter evidenced the dependence on the applied organic loading. The continuous variations of the organic loading rates and the considerably high magnitude of such loads in addition to the high concentration of suspended solids could result in dynamic fluctuations between the individual waste components affecting the steady state condition of the organic conversion process causing that none of the three conditions studied have shown a significant improvement in the organic removal and in the gas production rate. However, occasional COD and TSS removals of 55% and 68%, respectively, were observed at the first flow rate condition of 92 l/d (24.3 gal/d). The portion of the influent COD remaining in the filter effluent was inversely proportional to the theoretical hydraulic retention time for a range of 5.1 to 10 hours. Therefore, the hydraulic retention time was the most important operating parameter of the anaerobic filter. (Munoz, Puerto Rico)
W83-02214

ADDITIONAL TREATMENT OF WASTEWATERS TO REMOVE NITROGEN COMPOUNDS IN AERATED OXIDATION PONDS,
Nauchno-Issledovatel'skii Inst. Kommunalnogo Vodosnabzheniya i Ochiski Vodi, Moscow (USSR).
L. I. Gyunter, E. V. Grebenevich, V. A. Vavilin, and V. B. Vasil'ev.
Water Resources (English Translation), Vol 9, No 1, p 104-109, January/February, 1982. 4 Fig, 1 Tab, 4 Ref. Translated from Vodnye Resursy, No 1, p 154-159, January-February, 1982.

Descriptors: Population dynamics, *Primary productivity, *Algae, *Oxidation ponds, *Wastewater treatment, Oxidation, Daphnids, Nitrogen, *Denitrification.

To determine the possibility of raising cladocerans on biologically treated wastewater containing microalgae, experimental investigations were carried out, and a mathematical model of the dynamics of the change in the population of daphnids was also developed. Experiments on determining the effect of various concentrations of green algae on the development and productivity of daphnids were carried out simultaneously with five concentrations of algae. The best conditions for development of the daphnid culture were created in a medium with an algal concentration of 150-300 mg/liter. The results of the study of dynamics of the increase of biomass of the zooplankton at various algal concentrations indicate that both the rate of increase and the maximum concentration of the daphnid culture depend on the algal concentration. (Baker-FRC)
W83-02241

ANAEROBIC TREATMENT OF WASTEWATER: THE GAS-LIQUID-SLUDGE SEPARATOR,
Centraal Inst. voor Industrietontwikkeling, The Hague (Netherlands).
R. R. van der Meer, and R. de Vletter.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1482-1492, November, 1982. 8 Fig, 5 Tab, 26 Ref.

Descriptors: *Sludge solids, *Separation techniques, *Foam separation, Settling, *Wastewater treatment, Anaerobic digestion, Digestion, Anaerobic upflow reactors, Plug flow, Laminar flow.

An integral gas separator-settler combination was designed to control the quantity of sludge leaving an anaerobic upflow reactor. First the influent, containing gas, liquid, and solid phases, is separated from the recirculating stream. After separation of gas, the suspension of solid matter and liquid loses dissolved gases in an expansion chamber. Finally sludge is separated in the settling compartment where laminar flow exists. As the sludge blanket is formed, it sinks back into the reactor through openings in the bottom plates, which are situated at an angle of 45 degrees. Studies were performed on reactors with volumes of 6, 30, and 200 cu m using acidified sugar factory wastewater (COD, 1300-2600 mg per liter) and by-products wastewater (COD, 7000-17,000 mg per liter). Solids separation efficiences were 96-99.5% at suspended solids concentrations up to 40 kg per cu m at the inlet to the settler. The fluid flow patterns varied with process conditions: regions of plug flow and regions of good mixing at low sludge concentrations in the sludge blanket, laminar flow at low gas production rate, and some dead space in the reactor and settler at high sludge concentrations. (Cassar-FRC)
W83-02258

REMOVAL OF TOXIC METALS FROM POWER-GENERATION WASTE STREAMS BY ADSORPTION AND COPRECIPITATION,
Washington Univ., Seattle. Dept. of Civil Engineering.
M. M. Benjamin, K. F. Hayes, and J. O. Leckie.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1472-1481, November, 1982. 16 Fig, 3 Tab, 23 Ref.

Descriptors: *Trace metals, *Adsorption, *Iron hydroxide, *Wastewater treatment, Industrial wastewater, Metals, Powerplants, *Chemical precipitation, Fly ash, Hydrogen ion concentration, *Ions, Anions, Cations.

Adsorption/coprecipitation of ions commonly found in coal-fired power-plant wastes onto amorphous iron oxyhydroxide were studied using a mathematical model and experiments with actual wastes. pH was the primary factor controlling adsorption; increasing pH increased adsorption of cations and decreased adsorption of anions. To a lesser extent adsorption was affected by adsorbent concentration, concentration of other ions (especially copper) in solution, and complexing ligands. Adsorption of trace contaminants was similar in both the complex natural waste and the simpler synthetic waste. The stronger pH effect in synthetic waste was probably a result of competitive adsorption interaction and complexation by dissolved ligands. An acid metal cleaning waste proved suitable as the iron source for copreciptation. Ions included Zn, Cd, Cu, selenite, arsenite, and chromate. (Cassar-FRC)
W83-02260

LOW TEMPERATURE ANAEROBIC BIOFILTRATION IN UPFLOW REACTORS,
Duncan, Lagnese and Associates, Inc, Pittsburgh, PA.
J. A. Oleszkiewicz, and S. Koziarski.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1456-1471, November, 1982. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Anaerobic digestion, *Biofiltration, *Animal wastes, *Wastewater treatment, Hogs, Kinetics, Anaerobic upflow reactors.

An anaerobic biofilter, operated in an upflow mode, was used to treat dilute animal wastes on a pilot scale. Operating parameters were: temperature, 23-26C; organic loading, 0.4-6.55 kg COD per cu m per day; hydraulic retention time, 14-343 hours. Nonfiltered COD removals were 70-93%. Effluent with nonfiltered BOD of 210-1400 mg 02 per cu dm produced influent with nonfiltered COD of 9050-10500 mg 02 per cu dm and nonfiltered BOD of 4000 mg 02 per cu dm. Gas production increased gradually with increasing loading; average daily methane production was 0.024-0.171 cu m per kg COD removed. The optimum gas production was about half the maximum theoretical value of 0.35 cu m methane per kg COD removed at loadings of 3-4 kg COD per cu m per day. Removals of nitrogen were 30-50% total Kjeldahl N and 52-72% organic N. Optimum operating conditions were: loading, 3-4 kg COD per cu m per day; hydraulic retention time, 24 hours; effluent nonfiltered COD, 1500 mg 02 per cu dm; and 0.16 cu m methane per kg COD removed. (Cassar-FRC)
W83-02261

KINETIC ANALYSIS OF ALTERNATIVE CONFIGURATIONS FOR SINGLE-SLUDGE NITRIFICATION/DENITRIFICATION,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
B. Batchelor.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1493-1504, November, 1982. 8 Fig, 2 Tab, 17 Ref.

Descriptors: *Nitrification, *Denitrification, *Biological treatment, *Kinetics, *Wastewater treatment, *Single-sludge systems, Anaerobic treatment, Aerobic treatment, Oxidation, Model studies, Mathematical models.

A computer simulation model was developed to aid in the analysis of single-sludge wastewater treatment systems for biological nitrification/denitrification. Simulation of the intermittently aerated completely mixed (IACM) configuration showed the importance of 2 new process variables, aeration fraction and cycle time ratio. The aeration fraction, which represents the relative activity of the aerobic and anaerobic microbial reactions, determines the relative amounts of nitrate and ammonia in the effluent organic matter concentration. The cycle time ratio represents the degree of non-steady-state conditions caused by intermittent aeration. Lower cycle time ratios produced significantly lower effluent nitrogen concentrations. A simplified first-order kinetic model was used to evaluate alternative reactor configurations for single-sludge systems. As the cycle time ratio decreased, all of the reactor configurations could be described as completely mixed basins with kinetic coefficients averaged over aerobic and anaerobic cycles. This method is applicable to other configurations operated at low cycle time ratios. Simple procedures are given for analysis of three configurations: IACM, the series of completely mixed basins with recycle, and plug flow reactors with intermittent aeration and mixed liquor recycle. (Cassar-FRC)
W83-02262

ANAEROBIC TREATMENT OF THERMAL CONDITIONING LIQUORS,
Gore and Storrie Ltd., Toronto (Ontario). Wastewater Projects Div.
For primary bibliographic entry see Field 5E.
W83-02282

COST INDEX TRENDS AND COMPARISONS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 6C.
W83-02285

ALGAL AVAILABILITY OF PHOSPHORUS IN MUNICIPAL WASTEWATER,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
T. C. Young, J. V. DePinto, S. E. Flint, M. S. Switzenbaum, and J. K. Edzwald.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1505-1516, November, 1982. 11 Fig, 5 Tab, 31 Ref.

Descriptors: *Phosphorus, *Algae, *Wastewater composition, Model studies, Bioassays, Nutrients, Wastewater treatment, Fate of pollutants, Municipal wastewater, New York, Minnesota.

Scenedesmus sp bioassays of wastewater influent, effluent, and an intermediate process collected from 4 wastewater treatment plants in the Great Lakes area indicated that short-term (14-day) availability of soluble phosphorus (82%) was significantly greater than that of particulate P (55%). Total short-term available P averaged 72% of total

wastewater P. Analysis of the short-term data by a first order model showed that 100% of the soluble P and 63% of particulate P were ultimately available for algal uptake. Rates at which both fractions become available were 0.27 per day. The type of treatment (activated sludge, combinations of chemical additions, aeration, trickling filter, etc.) did not affect P availability. P availability decreased with treatment by 70-96%, except in one plant using a split stream of 80% conventional activated sludge and 20% primary treatment with alum and polymer. Available P was not selectively removed by the treatments covered in this study. This nonselectivity was unaffected by influent concentration (2.4-7 mg per liter), physical form of influent P (40-75% particulate), or type of treatment. Since soluble P is much more bioavailable on the short-term, treatment methods to minimize this component are preferable. (Cassar-FRC)
W83-02286

THERMODYNAMIC EVALUATION OF WATER POLLUTION CONTROL PROCESSES,
Puerto Rico Univ., Mayaguez. Dept. of Chemical Engineering.
R. Munoz-Candelario.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181966, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, Puerto Rico Water Resources Research Institute, Mayaguez, March 1983. 18 p, 2 Fig, 2 Tab, 7 Ref. OWRT A-058-PR(1), 14-34-0001-9041.

Descriptors: *Thermodynamics, Efficiences, *Wastewater treatment, *Entropy, *Energy losses, Heat, Activated sludge process, Trickling filter system, Water pollution control.

A thermodynamic analysis of the processes used to control water pollution shows that absolute values of their true thermodynamic efficiences can not be determined either experimentally or analytically. It is demonstrated that for processes achieving the same degree of purification on a given wastewater, the true thermodynamic efficiences increase as the respective energy requirements decrease. The practical thermodynamic efficiency of the activated sludge process was found to be lower than that of the trickling filter system for the treatment of municipal wastewaters. For capacities from 0.1 to 5.0 mgd, the values for the activated sludge process ranged from 63.9 to 69.7%, while those for the trickling filter operation varied from 69.4 to 70.3%.
W83-02322

BENEFITS FROM JOINT TREATMENT OF MUNICIPAL AND POULTRY PROCESSING WASTEWATER,
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
D. J. Epp, C. E. Young, and D. Rossi.
Water Resources Research, Vol 18, No 5, p 1587-1590, October, 1982. 1 Fig, 5 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Poultry wastes, *Food processing plants, Filters, Cost analysis, Municipal wastewater.

This paper presents results of research on the costs of joint and separate treatment of wastewater by small rural communities and poultry-processing plants. Three sizes of poultry processing plants (51,000 to 207,000 birds per day) and sizes of communities (3,000 to 20,000 people) were studied and costs were developed for lagoon, activated sludge, and trickling filter systems. Lagoon systems were cost effective for both separate and joint treatment. Trickling filter systems cost less than activated sludge systems when only domestic wastes are treated. The reverse is true when poultry processing wastes are introduced. When activated sludge or lagoon treatment is used, joint treatment gives a substantial cost saving for any size of poultry processing plant, regardless of community size. The potential savings from joint treatment are sufficient to pay for up to 6 miles (9.6 km) of gravity main transmission of poultry processing plant wastes to a municipal treatment plant. (Baker-FRC)
W83-02333

OXIDATION OF BIOLOGICAL SLUDGES WITH OZONE,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
S. Farooq, and S. Akhlaque.
Journal of Environmental Science and Health, Part A, Vol 17, No 5, p 609-637, 1982. 14 Fig, 2 Tab, 11 Ref.

Descriptors: *Activated sludge, *Sludge conditioning, *Ozonation, *Bottom sediments, Hydrogen ion concentration, Alkalinity, Digested sludge, Chemical oxygen demand, Heavy metals, Oxidation, Sludge disposal.

Sludge disposal problems can be alleviated by reducing the volumes of sludges following biological digestion, principally via improved dewatering. The effects of using ozone as a conditioning and oxidizing agent on the pH, alkalinity, heavy metal release and chemical oxygen demand (COD) of sludges were examined in a return activated sludge, a thickened sludge, an anaerobically digested sludge, and lake bottom sediments (control sludge). After ozonation in a glass batch reactor, heavy metals were released from the sludges. As a result of ozonation, odor was completely eliminated, dissolved COD increased and total COD was considerably decreased. Ozone-treated sludge showed increases in alkalinity and improvements in color. Upon ozonation, the pH of the return activated sludge increased from 6.7 to 6.9 then remained stable and later decreased to 5.9. The pH of the digested sludge increased from 7.3 to 8.1 and the thickened sludge followed the same trend. The pH of the sludge from the lake bottom remained almost neutral throughout ozonation. (Geiger-FRC)
W83-02334

THE EFFECTS OF LOW DISSOLVED OXYGEN TENSION DURING THE AEROBIC TREATMENT OF PIGGERY SLURRY IN COMPLETELY MIXED REACTORS,
West of Scotland Agricultural Coll., Auchincruive. Dept. of Microbiology.
M. P. W. Smith, and M. R. Evans.
Journal of Applied Bacteriology, Vol 53, No 1, p 117-126, 1982. 6 Fig, 3 Tab, 23 Ref.

Descriptors: *Animal wastes, *Dissolved oxygen, *Nitrification, *Wastewater treatment, Manure, Oxygen, Aerobic treatment, Denitrification, Ammonia, Nitrogen, Bacteria, Sewage bacteria, *Piggery wastes.

The effects of low dissolved oxygen (DO) concentrations during treatment of piggery wastes in an aerobic reactor were studied. At 15C the removal of carbonaceous material was the same over the range of 0.1 to 40% saturation. However, below 15% of oxygen saturation the quantity of input N which remained in the slurry was directly proportional to the average DO level. The organic N (or nonconvertible) fraction was unaffected was unaffected by DO levels and stayed near 800 mg per liter over the 3.5-10 day range of residence time. However, the ammonia-N (or convertible fraction) remaining in the slurry was directly proportional to the average DO and DO levels < 15% saturation. Up to 45% of total input N and up to 85% of convertible N could be lost at low DO levels. This loss was a result of nitrification-denitrification. Low DO levels favored nitrification because denitrifying bacteria raised the pH to favorable levels. Control of pH at 7.1 reduced the variability of nitrification-denitrification and produced complete oxidation of ammonia even at low DO levels. (Cassar-FRC)
W83-02335

POTENTIAL OF ALGAL PRODUCTION,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
J. U. Grobbelaar.
Water SA, Vol 8, No 2, p 79-85, April, 1982. 6 Fig, 1 Tab, 21 Ref.

Descriptors: *Wastewater treatment, *Algal growth, *Biomass, *Oxidation ponds, *Chlorophyta, *Mathematical models, Aquatic productivity, Oxidation process, Model studies, Water temperature, Light intensity, Water depth, South Africa.

Mass algae cultivation has been carried out for purposes of food production, waste treatment, and bioenergy conversion. The best results with mass algal culture have been in the field of sanitary engineering, where algae are used to treat wastewater in oxidation ponds. Dense open outdoor cultures of algae are prone to infections and parasitism, especially by protozoa and rotifers, which can affect the yield and quality of the biomass. A mathematical model has been developed, calibrated and verified in a study to optimize algal production rates. The model takes into account the effects of light intensity, depth, and water temperature on the rate of biomass growth. The model may be used in predicting optimal biomass concentrations for use in outdoor algal ponds. (Geiger-FRC)
W83-02374

SELECTION OF ALGAL SPECIES FOR USE IN OUTDOOR MASS CULTURES,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
M. M. J. Van Vuren, and J. U. Grobbelaar.
Water SA, Vol 8, No 2, p 86-91, April, 1982. 7 Fig, 21 Ref.

Descriptors: *Wastewater treatment, *Algal growth, *Light intensity, *Algae, Nutrients, *Chlorophyta, *Water temperature, Biomass, Model studies, Scenedesmus, Chlorella, Mathematical models, South Africa.

Algae have been grown by mass cultivation techniques for use in food production, waste treatment, and bioenergy conversion. The criteria used to select an alga for each application are based on general characteristics such as growth rates, harvestability, resistance to predation and infection, and specific characteristics which apply to the intended application. For food production, high protein content, good digestibility, and favorable amino acid content are important. For the treatment of wastes, algae must have a high nutrient uptake capability, the possibility of heterotrophic growth, tolerance of low oxygen levels and good resistance to bacterial contamination. For bioenergy conversion, algae should possess a high carbohydrate content and low rates of respiration and organic excretion. Test were conducted on Scenedesmus bijugates and Chlorella species to determine the response of these algae under different temperatures, light intensities and nutrient supplies in terms of growth rates, activation energy, yield coefficients, half-saturation constants and protein contents. These preliminary tests are being studied for use in a larger program to classify algal strains according to their possible utilization, and for use in establishing parameters for mathematical model building. (Geiger-FRC)
W83-02375

TREATABILITY ANALYSIS OF DIGESTER SUPERNATANT AND OTHER RETURN FLOWS TO IMPROVE WASTEWATER TREATMENT PLANT EFFICIENCY,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
P. C. Singer, and D. F. Lawler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187187, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 182, Univ. of North Carolina, Raleigh, July 1982. 122 p, 37 Fig, 23 Tab, 20 Ref. OWRT A-089-NC(1), 14-34-0001-7070.

Descriptors: *Sludge digestion, *Wastewater treatment, *Sludge dewatering, Dewatering, *Return flow, *Anaerobic digester supernatant, *Anaerobic digestion.

The significance of return flows from anaerobic digesters and sludge dewatering devices was assessed at five municipal wastewater treatment plants. Digester supernatant was found to represent an important waste load being returned to the

main wastewater treatment processes for several pollutants of interest, notably suspended solids, nitrogen and phosphorus. Inefficient solid-liquid separation in the digesters, due to both design and operating limitations, was found to be the major cause of this situation. Waste flows from sludge dewatering facilities were less significant due to better solid-liquid separation. Laboratory treatability studies conducted on anaerobic digester supernatant indicated that chemical treatment of the supernatant prior to its return to the plant influent could markedly improve its quality, but that such treatment is not necessary if good solid-liquid separation in the digesters could be achieved. The results suggest that substantial improvements both in the design and operations of sludge digesters and subsequent dewatering processes are needed to alleviate the problems associated with the return of digester supernatant. Such improvements are discussed.
W83-02411

THE APPLICATION OF DEVELOPMENTS IN ANAEROBIC DIGESTION WITHIN SEVERN-TRENT WATER AUTHORITY,
Severn-Trent Water Authority (England). Lower Trent Div.
C. E. Brade, G. P. Noone, E. Powell, H. Rundle, and J. Whyley.
Water Pollution Control, Vol 81, No 2, p 200-219, 1982. 5 Fig, 8 Tab, 13 Ref.

Descriptors: *Anaerobic digestion, *Sludge digestion, *Detention time, *Wastewater facilities, *Operating costs, *Capital costs, Digestion, Wastewater treatment, Digested sludge, Sludge, Cost analysis, *England, Severn-Trent Water Authority.

In 1975 and 1976, surveys of Severn-Trent Water Authority digestion plants were carried out. Results of these evaluations indicated a need for greater definition of process design parameters. A Sludge Digestion Studies Group was formed to monitor progress on projects focussing on the effects of reduced detention period, methods of sludge mixing and heating, techniques of sludge feeding, and construction of digestion tanks and conversion of existing tanks. The basic process design requirements are reviewed, along with operations at the Mansfield, Shirebrook and Pitts Mill plants, which exemplify three different ways of meeting some of these requirements. The digester at Mansfield was uprated by installing new process equipment. The large size of the Mansfield operation along with the remaining life of the tank and pumphouse structures helped to maintain low unit capital costs. In order for the smaller Shirebrook plant to realize an operating costs savings, gas collection and storage would have to be conducted to reduce fuel costs. The Shirebrook unit was also uprated by installing new process equipment. In contrast, the rural Pitts Mill plant is a small and expensive prefabricated complete digestion package. The construction of new digestion plants of shorter design detention period coupled with improved process equipment and more sophisticated control equipment is resulting in an overall reduction in cost and an increase in reliability. Lengthy discussion of these works, replies to the discussion and some appendices are included. (Geiger-FRC)
W83-02413

LOW-COST PROVISION OF ANAEROBIC DIGESTION: II. HIGH-RATE AND PREFABRICATED SYSTEMS,
Severn-Trent Water Authority, Birmingham (England).
G. P. Noone, and C. E. Brade.
Water Pollution Control, Vol 81, No 4, p 479-510, 1982. 16 Fig, 11 Tab, 30 Ref.

Descriptors: *Sludge digestion, *Anaerobic digestion, *Process control, Digestion, Retention time, Performance evaluation, Monitoring, Design criteria, Costs, Capital costs, Biological treatment, Sludge treatment.

A progress report is presented on continuing studies of low cost anaerobic sludge digestion systems. Revised interim design parameters are: 15 days maximum retention at 35C, a minimum feed sludge solids of 4%, a minimum tank aspect ratio of 1, a minimum floor slope of 45 degrees, a maximum power of 5 W per cu m, and a mixing volume of 0.00647 N cu m per sq m per min. Two designs of low cost digesters were described. One used process equipment designed for other industries; the other used prefabricated structures. The cheapest and most reliable indicators of digester performance were odor and appearance, gas volume, gas quality, volatile/total acids ratio, and propionic acid level. Effective and stable digestion at full scale was possible with retentions as low as 7.5 days and loadings as high as 6.5 kg DOM per cu m per day. Remaining possibilities for reducing the cost of anaerobic digestion are increases in feed sludge concentration, additional use of prefabricated structures, direct steam heating reducing capital costs, and reducing corrosion of gas collection and storage structures. (Cassar-FRC)
W83-02424

MEMORANDUM OF EVIDENCE TO THE ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION,
For primary bibliographic entry see Field 5G.
W83-02425

APPLICATION OF CRYO-CUT METHOD FOR MEASUREMENTS OF BIOFILM THICKNESS,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
G. H. Kristensen, and F. P. Christensen.
Water Research, Vol 16, No 12, p 1619-1621, December, 1982. 4 Fig, 9 Ref.

Descriptors: *Biofilms, *Microscopic analysis, *Cryo-cut method, *Wastewater treatment.

The cryo-cut method is used to measure the thickness of biofilm in a laboratory-scale reactor. Very thin waterproof, transparent tape installed in the reactor accumulates biofilm. For measuring the biofilm thickness, a bit of tape is cut off and imbedded in Tissue-Tek in a cryo-cut microtome at -25C. Slices 50-150 microns thick are cut and photographed in an interference contrast microscope. Examination of biofilms subjected to a pH rise showed a dense layer (calcium phosphate) in the rear part of the biofilm. This zone disappeared upon the addition of a few drops of 10% acetic acid. In another experiment, the flocs found in fluidized bed reactors were demonstrated to be hollow, a result of the decompositon of the innermost organisms. (Cassar-FRC)
W83-02426

REDUCTION IN CHLORINE REQUIREMENTS BY CONTROL OF NITRIFICATION IN AN OXYGEN ACTIVATED SLUDGE PROCESS,
Houston Univ., TX.
J. V. Matson, J. F. Andrews, and M. T. Garrett.
Water Research, Vol 16, No 7, p 1083-1091, July 1982. 6 Fig, 2 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Nitrification, *Activated sludge process, *Chlorine, *Ammonia, *Cost analysis, Chlorination, Activated sludge, Process control, Hydrogen ion concentration, Graphical methods, Texas, Houston.

Studies were carried out in two portable treatment units on the site of the proposed Houston 69th Street City 100 MGD Sewage Treatment Plant to determine whether chlorine could be saved by controlling nitrification in an oxygen activated sludge process so that the effluent would produce an ammonia concentration in the 2-4 milligrams/liter range. It was theorized that the ammonia would react with the chlorine to produce a stable combined residual at a much lower chlorine dosage than if the effluent were completely nitrified. Results with the portable units showed that the chlorine requirements could be reduced by 50% or more if nitrification was controlled. Gross savings of chlorine were an estimated $250 thousand annually. There was no apparent effect of pH on chlorine residual in the range of 6.5-7.5 and no change when the nitrification stage was operated with either air or high purity oxygen. (Geiger-FRC)
W83-02427

THE INFLUENCE OF ORGANIC LOADING AND RETENTION PERIOD ON THE PERFORMANCE OF THE ROTATING DISK SYSTEM,
P. S. Cheung, and G. Mack.
Water Pollution Control, Vol 81, No 4, p 553-557, 1982. 7 Fig, 2 Tab, 13 Ref.

Descriptors: *Nitrification, *Organic loading, *Retention time, Wastewater treatment, Biological oxygen demand, Rotating biological contactors, Hydraulic loading, Biochemical oxygen demand, Federal Republic of Germany, Stuttgart.

A rotating disk system built 17 years ago to treat wastewater from Stuttgart-Busnau was used in plant scale tests. BOD removal and nitrification efficiencies varied with the BOD loading. High BOD removal occurred at low organic loading. Nitrification efficiency was near 100% for BOD loadings up to about 5 g BOD per sq m per day and decreased markedly with increased organic loading. Shorter retention periods decreased BOD removal efficiency. A 3 hour retention period was a reasonable compromise for maximum BOD removal efficiency and minimum tank size. Dilution of the effluent with groundwater (2.4 liters per sec added to 3.0 liters per sec of sewage) improved nitrification efficiency even at shorter retention periods. It was suggested that treated effluent be recirculated to the treatment plant to achieve a higher nitrification efficiency. (Cassar-FRC)
W83-02428

THE ROLE OF PHOSPHORUS IN ACTIVATED SLUDGE,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
Y. C. Wu, and M. S. Okrutny.
Water Pollution Control, Vol 81, No 4, p 558-565, 1982. 8 Fig, 3 Tab, 16 Ref.

Descriptors: *Phosphorus, *Nutrients, *Limiting nutrients, *Wastewater treatment, Bacteria, Activated sludge process, Chemical oxygen demand, Carbohydrates, Protein, Growth rate, Sludge.

The effect of phosphorus limitation on the activated sludge process was investigated in batch and continuous experiments. Batch studies revealed that the relationship between cell specific growth rate and limiting P concentration was described by a Monod equation. The growth rate of mixed culture varied from 0.092 to 0.64 per hour and the cell yield varied from 25.5 to 117.5 over the COD:P ratio range from 788:1 to 10:1. Maximum specific growth rate was 0.64 per hour, and the saturation constant was 0.378 mg per liter. Specific growth was inversely proportional to cell yield. In the continuous flow culture biological solids production and COD removal were greatly inhibited when the P concentration was less than 5.1 mg per liter or the COD:P ratio was greater than 105:1. Increasing the COD:P ratio increased efficiency of organic substrate removal and ammonia N uptake. Increasing P supplementation significantly reduced cell yield. Sludge carbohydrate as a percentage dry weight increased and sludge protein decreased with decreases in P levels, especially when P was less than 4 mg per liter. Cells in P-limited media had large capsules. (Cassar-FRC)
W83-02429

NEW DEVELOPMENTS IN THE ANAEROBIC TREATMENT OF INDUSTRIAL WASTES,
Water Research Centre, Stevenage (England).
F. E. Mosey.
Water Pollution Control, Vol 81, No 4, p 540-552, 1982. 8 Fig, 4 Tab, 23 Ref.

Descriptors: *Sludge digestion, *Anaerobic digestion, *Industrial wastes, Reviews, Wastewater treatment, Digestion, Farm wastes, Animal wastes, Microbiology, Bacteria, Methane bacteria, Fermentation, Process control, Monitoring, Upflow anaerobic sludge blanket, Fluidized beds.

The last 10 years' developments in anaerobic treatment of industrial wastes are reviewed. In microbiology, pure cultures of methane bacteria have been prepared, reaction kinetics have been studied, and the mechanism of fermentation elucidated. Four groups of interdependent bacteria are active: acid forming, acetogenic, acetoclastic methane, and hydrogen-using methane. New gas monitors have aided in process control. Recent designs in equipment include internal heat exchangers removable for cleaning, low-cost farm waste digesters (insulated trench, tanks with polyvinyl chloride gasholder roofs, fixed roof digesters with separate gas holders, and package plants). Industrial waste digesters for dilute wastewaters from the food-processing industry have concentrated on the upflow anaeorobic blanket reactor, anaerobic fluidized beds, and anaerobic expanded bed reactors. In sludge digestion the trends are toward high-rate digesters and package plants. Present problems in sludge digestion are poor process stability at short retention periods, too-slow destruction of fats and greases, inadequate destruction of pathogens, and heating and mixing difficulties. (Cassar-FRC)
W83-02430

A DECADE OF EXPERIENCE AT THE CALDER VALE WPC WORKS,
Yorkshire Water Authority (England).
P. Lowe.
Water Pollution Control, Vol 81, No 4, p 525-539, 1982. 10 Fig, 6 Tab, 7 Ref.

Descriptors: *Activated sludge process, *Sludge digestion, Wastewater treatment, Calder Vale Water Pollution Control Works, *United Kingdom, Sedimentation, Primary wastewater treatment, Screens, Biological filters, Lagoons, Tertiary wastewater treatment, Aeration, Anaerobic digestion, Digestion, Sludge disposal, Land application.

The Calder Vale sewage works in Yorkshire was expanded and updated in three phases starting in 1967. The plant's present operation is described in detail. Flows up to 81,500 cu m per day enter the plant. Excess is discharged to the River Calder. Treatment consists of bar screening, primary sedimentation in tanks, and aerated biological treatment. Sludge is digested, dewatered, and applied to agricultural land. Digester gas is burned to provide heat for the digester process. In 1976 a new inlet works, built within the original brick structure, was commissioned. Major features were three new screw pumps, modification of the curved-bar screens to allow flexing, and spiral-flow detritors. In the primary sedimentation tanks sludge scraping machinery, hoppers, and baffling were installed. Problems were encountered with the scraping machinery and solids loss from the sedimentation tanks. A tertiary lagoon was somewhat helpful in reducing effluent solids concentration. A new filter feed channel and collection channel were among the improvements made to the biological filters. The sludge digester plant, commissioned in 1968, experienced several problems in charging, emptying, valve malfunctions, corrosion in the boiler tubes, explosion of leaked gas, condensation of water in the gas lines, poor transmission of gas to the boiler, sludge buildup on the outside of the Heatamix tubes, and poor settleability of sludge solids. Sludge dewatering and disposal are described. (Cassar-FRC)
W83-02431

COMPLETE TREATMENT OF SEWAGE IN A TWO-STAGE FLUIDIZED-BED SYSTEM. PART 1,
Water Research Centre, Stevenage (England).
P. F. Cooper, and D. H. V. Wheeldon.
Water Pollution Control, Vol 81, No 4, p 447-464, 1982. 8 Fig, 13 Tab, 15 Ref.

Descriptors: *Fluidized beds, *Biological wastewater treatment, *Denitrification, Wastewater treatment, Nitrification, Anaerobic digestion, Aerobic digestion, Digestion, Suspended solids, Performance evaluation, Biomass, Oxidation.

Part of a series on two-stage fluidized bed treatment, this paper reports data obtained in characterizing the anoxic and aerobic reactors. Settled sewage up to concentrations of 200 mg per liter suspended solids was successfully used as a carbon source of denitrification. A high rate of denitrification (5-10 kg nitrate per cu m per day) was achieved. This was 5-10 times higher than in suspended growth systems and corresponded to a retention period of 5-10 min. Two methods for starting up an anoxic fluidized bed proved satisfactory. Passing mixed feed through the system at the flow velocity selected for the experiment was easier than the batch/total recycle method, which used a fresh batch of equal volume of settled sewage and nitrified effluent each day for 4 days. Good BOD removal from the anoxic reactor effluent was attained in the aerobic reactor at high volumetric rates of removal. When the aerobic reactor was produced. This was probably a result of formation of carbon dioxide bubbles and stripping of the biomass. Rapid seeding of the aerobic reactor was done by two methods: (1) the batch feeding/total recycle method and (2) a method using anoxic effluent and nitrate with oxygenation after 11 days growth. An automated sand/biomass separation system produced a sludge containing 6-10% and 4% w/w dissolved solids from the anoxic and aerobic reactors, respectively. The process featured a high speed stirrer and vibrationg sieve. (Cassar-FRC)
W83-02433

MECHANISMS OF BIOLOGICAL PURIFICATION ON ACTIVATED CARBON (MECANISMES DE L'EPURATION BIOLOGIQUE SUR CHARBON ACTIF),
Rennes-1 Univ. (France).
K. Gaid, C. Cavelier, and G. Martin.
Water Research, Vol 16, No 1, p 7-17, January, 1982. 8 Fig, 6 Tab, 5 Ref. English summary.

Descriptors: *Wastewater treatment, *Activated carbon, *Adsorption, *Organic matter, *Porosity, *Bacteria, Organic wastes, Biological wastewater treatment, Correlation analysis, Enzymes, Amino acids, Microorganisms.

The role of adsorbent fixing properties and microorganisms in the treatment of wastewater by activated carbon was examined in a survey of the adsorption properties of activated carbon, studies of the role of fixation sites on the carbon surface, and correlation analyses of the organic pollutants removed with the bacterial mass present on the adsorbing material. Results showed that the microporosity of carbon does not play a significant part in the adsorption of organic matter in sewage, but it does affect the adsorption of certain individual molecules, such as amino acids and enzymes. The presence of fixation sites (metals, surface functions) can have some effect during bacterial development. Research is now in progress to determine the role of specific surface in regard to the adsorbable molecules and its correlation with the bacterial mass. Studies are also underway to assess the part played by the adsorbing material and bacteria in relation to nonadsorbable molecules such as methanol and ethanol. (Geiger-FRC)
W83-02434

5E. Ultimate Disposal Of Wastes

PATHOGEN SURVIVAL DURING FORCED AERATION COMPOSTING OF MUNICIPAL WASTEWATER SLUDGE,
New Hampshire Univ., Durham. Water Resource Research Center.
P. L. Bishop, and W. R. Chesbro.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175323, Price codes: A08 in paper copy, A01 in microfiche. Research Report No. 37, December 1982. 157 p, 33 Fig, 30 Tab, 105 Ref. OWRT B-006-NH(3), 14-34-0001-0272.

Descriptors: Compost, *Pathogens, Sludge, Disinfection, *Coliforms, Aspergillus, Nutrients, Nitrogen, Wastewater treatment, *Sludge treatment, *Municipal sludge, *Composting, Bacteria, *Streptococci.

This research investigated the potential for survival of pathogen during and after composting of municipal wastewater sludge by forced aeration, static pile composting method. Both primary and combined primary/secondary sludges were composted. In general, pathogen kill, based on enumeration of fecal indicator organisms and of selected pathogens, was achieved in the deep sections of the compost piles where temperatures reached the thermophilic range. Pathogen kill was not complete in shallower areas of the pile, though, where temperatures did not rise above the mesophilic range. On the order of 100 fecal coliforms and fecal streptococci per gram of compost were still present at the end of the compost period in the shallow samples. Asperfillus fumigatus was detected at all stages of the compost cycle, throughout the piles. Salmonellae and Shigella were never detected in finished compost, due either to competition from native organisms or to severe dessiccation. Fecal coliforms and fecal streptococci in compost added to soil can survive for periods up to two years. Their numbers decrease to non-detectable during cold weather, but they may exhibit regrowth in warmer months. The fecal streptococci detected may be contributed by insects in the soil, rather than by the compost. Although there may be an initial increase in nitrogen in the compost due to nitrogen fixation, overall there is a net loss of nitrogen during the composting process due to mineralization of organic nitrogen, subsequent volatilization of ammonia and denitrification.
W83-02187

EXTRACTABILITY AND SOLUBILITY OF PHOSPHATE IN SOILS AMENDED WITH CHEMICALLY TREATED SEWAGE SLUDGES,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
Y. K. Soon, and T. E. Bates.
Soil Science, Vol 134, No 2, p 89-96, August, 1982. 2 Fig, 5 Tab, 20 Ref.

Descriptors: *Phosphates, *Sewage disposal, *Land disposal, Anaerobic digestion, Wastewater treatment, Sludges, *Sludge disposal, Solubility, Loam, Sand, Calcium, Iron, Aluminum, *Ontario.

The extractability and solubility of phosphate in soils amended with anaerobically digested sewage that resulted from treatment of sewage with Ca(OH)2, A12(SO4)3, or FeCl3 were characterized. The sludges were applied annually to field plots situated on a loamy sand (pH 7.3) and a loam (pH 7.4) and cropped to corn or bromegrass for 7 years. Extractibility of soil P by NaHCO3 was in the decreasing order of Ca-sludge, Fe-sludge, Al-sludge. Equilibrium P concentration was highest in the loam treated with Ca-sludge and in the loamy sand treated with Fe-sludge. The solubility of P in Ca-sludge-amended soil appeared to be limited by the precipitation of octacalcium phosphate. The Fe-sludge decreased soil pH, and this increased P solubility. Soil Fe and Al oxide content was increased by sludge application. This increased P retention in soil occurred through sorption and occlusion by the oxides. Calcite in the Ca-sludge-amended soil provided additional sorption sites. Fractionation of soil P showed that just over 50% of inorganic P in the Ca-sludge treatment and about 70% in the Al- and Fe-sludge treatments were Al- plus Fe-P. The relatively high Al- plus Fe-P in the Ca-sludge treatment resulted from the use in 1977 of a sludge treated with Ca and Fe. More P was present as loosely bound P and as a Ca-P in the Ca-sludge treatment than Al- and Fe-sludge treatments. (Baker-FRC)
W83-02198

FULL-SCALE THEMOPHILIC DIGESTION AT THE WEST-SOUTHWEST SEWAGE TREATMENT WORKS, CHICAGO, ILLINOIS,
Metropolitan Sanitary District of Greater Chicago, IL.
R. R. Rimkus, J. M. Ryan, and E. J. Cook.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1447-1457, November, 1982. 6 Fig, 3 Tab, 9 Ref.

Descriptors: *Digestion, *Sludge digestion, *Anaerobic digestion, *Thermophilic digestion, Meso-

philic digestion, Chicago, *Illinois, Energy, Methane.

In the hopes of increasing digestion capacity, one mesophilic sludge digester at a wastewater treatment facility in the Metropolitan Sanitary District of Greater Chicago was converted to the thermophilic process during a 130 week study. A stable thermophilic digester was established after a year's work. Although a 14-day detention time was achieved early in the study, a 7-day detention time was not reached until weeks 85-92 and again at 120-130. Comparing thermophilic digestion with mesophilic digestion, the volatile fatty acids were 270 and 40 mg per liter, respectively; pH, 7.8 and 7.6; alkalinity, 4500 and 4240 mg per liter; gas production, 0.40 and 0.32 cu m per kg volatile solids fed; volatiles reduction, 34.0 and 31.3%; and ammonia-N, 1200 and 1000 mg per liter. Methane content of digester gas, COD reductions, and fat-oils-grease reductions were similar in both systems. Thermophilic sludge had a slightly more intense odor than mesophilic sludge. The thermophilic digester was not upset by a 3C temperature increase or an increase in volatile solids loading of 2.40 to 4.64 kg per cu m per day at the rate of 10% increase per day. Although energy requirements of the thermophilic process were 120% greater than those of the meso processes, it is believed that this may be offset by the increased gas production and reclamation of waste heat for preheating. (Cassar-FRC)
W83-02280

ANAEROBIC TREATMENT OF THERMAL CONDITIONING LIQUORS,
Gore and Storrie Ltd., Toronto (Ontario). Wastewater Projects Div.
G. V. Crawford, T. Alkema, M. Yue, and M. Thorne.
Journal of the Water Pollution Cntrol Federation, Vol 54, No 11, p 1458-1464, November, 1982. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Digestion, *Anaerobic digestion, *Sludge conditioning, Design criteria, SLudge digestion, *Thermal conditioning liquors, *Wastewater treatment, Lakeview Water Pollution Control Plant, Peel, *Ontario, Biological treatment, Anaerobic packed bed reactor, Secondary wastewater treatment.

Laboratory results on anaerobic packed bed reactor treatment of thermal conditioning liquors are reviewed and used as a basis for designing a full-scale system for the Lakeview Water Pollution Control Plant, Peel, Ontario. Thermal conditioning liquor consists of a mixture of raw sludge and waste activated sludge, which has a COD of 6000-8000 mg per liter and a BOD of 3000-4000 mg per liter. The present method of treating these strong wastes at Lakeview involves recycling the untreated liquor to the plant influent, which adds 1% of the volume but 12% of the BOD, mostly in dissolved form. Preliminary design estimates indicate that BOD and volatile acids could be reduced 80% with organic loadings of up to 16 g COD per liter of initial reactor void volume per day with hydraulic retention times of 1-218 hours. Gas production is expected to be 0.4-0.5 liters per g of COD destroyed; sludge production, 0.1 g per g of COD removed. No supplemental nutrients or pH buffering are likely to be needed. Potential problems in a large scale anaerobic packed bed reactor are bed plugging, unequal feed distribution, improper flow disposal, toxic materials, and shock loadings. For Lakeview's 2.1 cu m per sec of wastewater, a 675 cu m reactor would produce 3500 cu m gas per day and return 945 kg COD per day to the plant influent. Total capital costs are $450,000; annual operating costs, $50,000; and value of gas produced, $60,000 per year. Removal by the present process, recylcing untreated liquor to the influent, costs $230,000 annually. (Cassar-FRC)
W83-02282

OXIDATION OF BIOLOGICAL SLUDGES WITH OZONE,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W83-02334

IMPACTS OF INDIVIDUAL ON-SITE SEWAGE DISPOSAL FACILITIES ON MOUNTAIN VALLEYS - PHASE I,
Idaho Univ., Moscow.
S. P. Luttrell, and C. E. Brockway.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182147, Price codes: A04 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute, Moscow, Completion Report, January 1983. 52 p, 9 Fig, 29 Ref. OWRT A-084-IDA(1), 14-34-0001-2114.

Descriptors: *Septic tank, *Wastewater disposal, *Nitrates, *Phosphates, Domestic waste, Water quality, Aquifers, Sub-divisions, Nutrients, *Idaho, Big Wood River Vally.

The upper and middle Big Wood River Valley has experienced large population growth associated with recreational development. Much of this growth has been and will continue to be in rural areas, making private and small community water systems and individual on-site sewage disposal facilities necessary. There are currently about 85 approved subdivisions in the study area, with a projected build-out of 2,151 units, 713 of which are currently built. The currently sub-divided buildable area is approximately 5,860 acres of a total buildable area of approximately 21,270 acres. The current building density of non-sewered areas is approximately 6.64 acres per unit for the study area and approximately 1.60 acres per unit for the city of Bellevue. The projected building density of non-sewered areas is approximately 2.21 acres per unit for the study area and approximately 0.75 acres per unit for the city of Bellevue. It is assumed that individual and group on-site sewage disposal facilities currently contribute about 24,900 pounds per year of nitrate (N0 sub 3 -N) and about 4,500 pounds per year of soluble phosphate (P) into the groundwater. The Hailey Woodside treatment-disposal facility currently contributes about 4,100 pounds per year of N0 sub 3 -N and about 740 pounds per year of P to the groundwater. Nutrient loads under maximum projected development are expected to be around 95,000 pounds per year of N0 sub 3 -N and about 17,000 pounds per year of P.
W83-02372

GENERATION AND TREATMENT OF LEACHATE FROM DOMESTIC WASTES IN LANDFILLS,
Water Research Centre, Stevenage (England).
H. D. Robinson, C. Barber, and P. J. Maris.
Water Pollution Control, Vol 81, No 4, p 465-478, 1982, 15 Fig, 6 Tab, 21 Ref.

Descriptors: *Leachates, *Landfills, *Domestic wastes, Municipal wastes, Waste treatment, Wastewater treatment, Chemical oxygen demand, Ammonia, Chlorides, Volatile acids, Fatty acids, Aerobic digestion, Biological treatment.

Landfill leachates were recirculated through the landfills by spraying to produce leachate similar in composition to well-aged, stabilized wastes. BOD, ammonia, and chloride levels and total volume were considerably reduced by the 12-18 month treatment. However, the remaining excess leachate was too high in COD to release untreated to surface waters. A thin permeable cover was suitable for a landfill containing crude domestic wastes, and no cover was best for pulverized refuse. Aerobic biological treatment of fresh landfill leachates in the laboratory showed reduction of COD at temperatures as low as 5-10C. It was necessary to closely control the operating conditions and to add nutrient P. The retention time for substantial COD removal at 10C was 10 days or more. Treatment at 5C was less efficient but still feasible. (Cassar-FRC)
W83-02423

LOW-COST PROVISION OF ANAEROBIC DIGESTION: II. HIGH-RATE AND PREFABRICATED SYSTEMS,
Severn-Trent Water Authority, Birmingham (England).
For primary bibliographic entry see Field 5D.
W83-02424

A DECADE OF EXPERIENCE AT THE CALDER VALE WPC WORKS,
Yorkshire Water Authority (England).
For primary bibliographic entry see Field 5D.
W83-02431

PILOT PLANT STUDY ON SEWAGE SLUDGE PYROLYSIS--II,
NGK Insulators Ltd., Nagoya (Japan).
T. Kasakura, and M. Hiraoka.
Water Research, Vol 16, No 12, p 1569-1575, December, 1982. 6 Fig, 3 Tab.

Descriptors: *Sludge cake, *Sludge drying, *Incineration, Drying, *Pyrolysis, Pilot plants, Sewage sludge.

Three processes (drying-pyrolysis, direct pyrolysis, and incineration) for pyrolysis of sewage sludge were compared in pilot plant studies. The most cost effective and environmentally acceptable process was drying-pyrolysis, followed closely by direct pyrolysis. Pyrolysis prevented the oxidation of Cr(3+) to Cr(6+), but incineration produced Cr(6+). Heavy metals (especially Hg, Cd, Pb, and As) were released to the gas phase in all three processes. The dryer exhaust gas scrubber wastewater was high in BOD, ammonium ion, and phenolic compounds. The boiler exhaust gas scrubber wastewater was high in suspended solids, sulfate, chloride, and heavy metals. (Cassar-FRC)
W83-02435

5F. Water Treatment and Quality Alteration

REACTIONS OF CHLORINE DIOXIDE WITH HYDROCARBONS: EFFECTS OF ACTIVATED CARBON,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
A. S. C. Chen, R. A. Larson, and V. L. Snoeyink.
Environmental Science and Technology, Vol 16, No 5, p 268-273, 1982. 3 Fig, 2 Tab, 41 Ref.

Descriptors: *Water treatment, *Chlorination, *Disinfection, Activated carbon, *Hydrocarbons, Chlorinated hydrocarbons, Chemical reactions, Oxidations, Wastewater treatment, *Chlorine dioxide.

Chlorine dioxide (ClO2) is being investigated as a possible alternative to chlorine for use as a disinfectant in water and wastewater treatment. This study was designed to determine the products resulting from reactions between aqueous chlorine dioxide and some selected hydrocarbons either contained in aqueous solution or adsorbed on an activated carbon surface. Chlorine dioxide was found to react rapidly with hydrocarbons having benzylic hydrogen atoms in dilute aqueous solution. These hydrocarbons, including ethylbenzene, indan, Tetralin, diphenylmethane, and fluorene, reacted, probably via free radical pathways, to produce oxidized derivatives such as ketones and alcohols. Additional halogenated compounds were formed from the chlorine dioxide-hydrocarbon reaction in the presence of activated carbon, but it has not yet been determined whether the granulated activated carbon acts as a true catalyst for these reactions or whether the surface becomes chemically altered. When a hydrocarbon was allowed to react with chlorine dioxide in aqueous solution for 2.9 minutes at pH 3.5 and the reaction mixture was passed over a bed of HD3000 granular activated carbon, monochloro and/or dichloro derivatives were produced in addition to the oxygenated compounds observed in the absence of the carbon. Analysis of the activated carbon columns following application of dilute chlorine dioxide to the columns showed no production of volatile organic compounds, no TOX increase in solution conversion of about 30 percent of the chlorine dioxide to chlorate, and no additional production of halogenated compounds resulting from contact with the carbon. (Carroll-FRC)
W83-02103

UTILIZATION OF MOLECULAR OXYGEN AND SUNLIGHT IN THE OXIDATIVE PURIFICATION OF WATER,
West Virginia Univ., Morgantown. Water Research Inst.
For primary bibliographic entry see Field 5D.
W83-02134

CHARACTERIZATION OF ORGANIC CONTAMINANTS IN SELECTED POTABLE WATER SUPPLIES IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Chemistry.
M. Rodriquez-Flores.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178038, Price codes: A04 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Mayaguez, 1983. 54 p, 22 Fig, 2 Tab, 14 Ref. OWRT A-057-PR(1), 14-34-0001-1141.

Descriptors: Wastes, Water supply, *Potable water, *Organic compounds, Analytical techniques, *Puerto Rico, Water treatment, *Pollutant identification, Disinfection, *Chlorine compounds.

The principal objective of this study was to investigate the extent of pollution by organic compounds of the three largest municipal water supplies in Puerto Rico. It was found that there are a number of halogenated organic pollutants present in the municipal water utilities of the cities of San Juan, Ponce and Mayaguez, all of which have been included in the priority pollutant list of the Environmental Protection Agency. There are: chloroform, carbon tetrachloride, chlorodibromomethane, dichlorobromomethane, bromoform, and tetrachloroethylene. The concentrations of these pollutants range in the low parts-per-trillion range, which is the same order of magnitude Juan tap water, tetrachloroethylene, is not known to have a natural origin; therefore, its source is very likely the undue disposition of waste solvents and degreasers. The other compounds are known to be generated when chlorine reacts with the traces of humic material that remains in the water after sedimentation and filtration steps. To test this hypothesis a few tests were made on water from lake Carraizo and from the Rio Anasco, which individually supply most of the raw water to two of the municipal water utilities studied. The concentration of trihalomethanes in all raw waters was undetectable, lending credence to the aforementioned hypothesis.
W83-02218

GAS CHROMATOGRAPHIC ANALYSIS OF HALOCARBONS IN DRINKING WATER BY HEADSPACE EXTRACTION AND MIXED COLUMN SEPARATION,
Genoa Univ. (Italy). Inst. of Industrial Chemistry.
For primary bibliographic entry see Field 5A.
W83-02284

RURAL DRINKING WATER TECHNOLOGY TRANSFER ASSESSMENT,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
E. M. Roe, and W. E. Sharpe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181776, Price codes: A05 in paper copy, A01 in microfiche. Partial Completion Report September 1982. 79 p, 26 Ref, 5 Append. OWRT C-00192-T(No 0496)(3), 14-34-0001-0496.

Descriptors: *Technology transfer assessment, *Water quality, *Rural areas, Water treatment, Water supply, Wells, Pumps, Springs, Water, Water treatment equipment, Technology transfer programs, Evaluation, *Rural drinking water, *Technology transfer needs, *Drinking water quality, Small water systems, Information needs, Private water systems.

The assessment of rural drinking water technology transfer needs begins with a short discussion of drinking water problems, in general, followed by the search strategy. In order to identify technology transfer programs and publications, drinking water experts in agencies, associations and citizens groups were contacted, computerized literature searches conducted, and library materials consulted. Primary and secondary users of rural drinking water information are characterized and their needs discussed. Drinking water research and technology transfer programs and products relevant to small water systems owners/operators and individual well owners are discussed and evaluated. Names and addresses of contacts, lists of relevant associations, journal, conferences and technology transfer materials are given in the appendices. It was found that the information needs of small public and individual private water system owners are not being adequately met. Recommendations to improve transfer of technology to these clientele are given. These recommendations include: production of a public health awareness package; production of a water systems information handbook and water treatment fact sheets for primary users; sponsorship of water treatment conferences for secondary users, and finally, the updating of an existing water systems reference book especially useful to secondary users.
W83-02318

DEFLUORIDATION OF GROUNDWATER SUPLIES BY UPFLOW ACTIVATED ALUMINA ADSORPTION PROCESS,
North Dakota Univ., Grand Forks. Engineering Experiment Station.
Y. T. Hung.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182089, Price codes: A15 in paper copy, A01 in microfiche. Completion Report No 81-12-EES-01, December 1981. 316 p, 119 Fig, 13 Tab, 9 Ref, 1 Append. OWRT A-006-NDAK(1), 14-34-0001-0136.

Descriptors: Water supply, Groundwater, *Adsorption, *Water purification, *Coagulation, Separation techniques, *Water treatment, Chemicals, *Activated alumina adsorption process, *Defluoridation, *North Dakota.

An investigation was performed to determine the feasibility of removing fluoride ions from simulated and naturally occurring groundwater samples from representative locations in North Dakota, using batch chemical coagulation-precipitation and adsorption processes, and continuous adsorption processes. The batch chemical coagulation-precipitation and adsorption study involved the use of several agents. Of the eleven additives examined only aluminum sulfate and calcium hydroxide phosphate removed appreciable amounts of fluoride. At dosages of 3000 mg/1, aluminum sulfate and calcium hydroxide phosphate reduced initial fluoride concentrations by up to 97 and 48%, respectively. In the continuous flow adsorption study, the performance of columns packed with activated alumina was based on their ability to adsorb and remove fluoride ions from water samples pumped through each column. Results indicated that adjusting the initial pH to 5, increasing the amount of activated alumina, decreasing the activated alumina particle size, and reducing the flow rate had the greatest effect in improving effluent quality in terms of fluoride concentrations. Increasing alkalinity and TDS reduced the capacity of the alumina columns for adsorption. The operating cost for defluoridation of 10,000 gallons of raw groundwater was approximately $0.04 for a plant design flow of 1.5 MGD (million gallons per day).
W83-02366

SOLIDS CONTAMINATION RESULTING FROM DRAINAGE WORKS IN AN UPLAND CATCHMENT, AND ITS REMOVAL BY FLOTATION,
Yorkshire Water Authority (England).
R. Austin, and D. Brown.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 4, p 281-288, 1982. 2 Fig, 6 Tab, 1 Ref.

Descriptors: *Soil erosion, *Flotation, *Turbidity, *Water treatment, Erosion, Holmestyes Reservoir, Afforestation, Water pollution sources, Water distribution, Sediment concentration, Soil management, Agricultural runoff, England.

Deep plowing for afforestation in the Holmestyes catchment, United Kingdom, exposed the underlying clay stata to servere erosion during heavy rainfall in October 1980. Turbidity of the raw water reached 1000 FTU, totally unsuitable for treatment. As a short-term remedial measure additional chlorine was dosed for the 11 hours between discovery of the pollution and plant shutdown. Cross-connections with alternative supplies were made. The extra load on the other treatment plants caused deteriorated water quality and numerous main bursts. Dosing the reservoir with lime and alum did not significantly improve the raw water in the short-term, requiring backup water from a compensation reservoir, to which overland plastic pipe was laid. As a long-term solution a package dissolved air flotation plant was installed. It became operational 11 months after the initial pollution problem. (Cassar-FRC)
W83-02377

CREATING THE DENVER WATER DEPARTMENT'S SECURITY PROGRAM,
Denver Board of Water Commissioners, CO.
R. G. Jenson.
Journal of the American Water Works Association, Vol 74, No 10, p 509-511, October, 1982.

Descriptors: *Risks, *Security, *Utilities, *Water treatment, Denver, *Colorado, Safety, Water pollution prevention, Drinking water, Water treatment facilities.

The Denver, Colorado, Water Department recognized the need for a security program in 1975. Although the department had not suffered security losses over its 60-year history, many possibilities for security problems existed, including 20 dams and reservoirs, 950 employees, 400 vehicles, 2 sophisticated computer systems, processing of $80 million in funds each year, 3 treatment plants, and inventories greater than $30 million. For the first 3 years of the program the plant division dealt with security problems that were specifically identified, such as perimeter fences, remote alarm systems, a modern lock and key system, employee pilferage, inventory control procedures, and a security guard system. To better meet the overall security needs the department hired a risk management consultant in 1978. Security was identified as a part of an overall risk management program. This program has not only saved money for the water department, but employee awareness of security problems has been heightened. In 1979 significant misappropriation of property was uncovered. Since then several steps have been taken to increase security. These include gates at the central administration building, equipping caretakers at remote facilities with firearms and guard dogs, remote entry systems for remote stations, an alarm system for the cashier operation, and termination of 12 department employees for drug-related offenses. (Cassar-FRC)
W83-02384

THE INTEGRATION OF SMALL-SCALE IRRIGATION AND VILLAGE POTABLE WATER SYSTEMS IN GUATEMALA,
Inter-American Foundation, Rosslyn, VA.
S. Annie, and S. B. Cox.
Water Supply and Management, Vol 6, No 5, p 455-464, 1982. 13 Ref.

Descriptors: Water resources development, *Irrigation programs, *Potable water, Rural areas, *Developing countries, *Guatemala, Water supply, Drinking water, Public health, Diseases, Benefits, Social aspects, Economic aspects, Springs, Gravity springs.

This paper proposes the integration of small-scale irrigation and potable water systems for rural villages in the Guatemalan highlands, which is richly endowed with springs. Currently potable water is brought from a supposedly clean spring by gravity feed to a distribution tank in the village. Feeder lines deliver water to individual homes or public taps. Estimates of the population currently having access to potable water vary from 15 to 45%. The small-scale irrigation projects are quite similar in construction to the potable water projects. Large

diameter polyvinyl chloride, steel, or concrete piping is used to bring water from a higher spring for application to the fields by sprinkler systems. Storage tanks are not used because the demand is constant. These two types of projects are often planned independently in the same building. It is recommended that feeder lines be added to the irrigation systems to bring water to homes or public taps. If the source is not a protected spring, treatment facilities or a parallel system using a safe spring must be constructed. Benefits of this integration are economies of scale, greater ease of promoting the project to the community, better possibilities for self-financing, and more efficient use of labor. Several issues must be resolved before starting an tintegrated program: engineering and technical, economic, program design, institutional, and community equity. (Cassar-FRC)
W83-02394

DETERMINING THE CONCENTRATION OF EASILY ASSIMILABLE ORGANIC CARBON IN DRINKING WATER,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
D. Van Der Kooij, A. Visser, and W. A. M. Hijnen.
Journal of the American Water Works Association, Vol 74, No 10, p 540-545, October, 1982. 7 Fig, 7 Tab, 38 Ref.

Descriptors: *Organic carbon, *Bacteria, *Pipes, *Pollutant identification, Assimilable organic carbon, Dissolved organic carbon, Polyvinyl chloride, Pseudomonas, *Water treatment, Water distribution, Bioassays, Drinking water, Water distribution, Microbial growth, Ozonation, Water analysis.

A method for determining the potential of a water for supporting microbial regrowth in a drinking water distribution system is described. This bioassay is based on the growth of Pseudomonas fluorescens as a function of the concentration of easily assimilable organic carbon (AOC), which includes humic and fulvic acids, amino acids, peptides, fatty acids, hydroxycarboxylic acids, and carbohydrates. A linear relationship was seen between the concentration of acetate C added to tap water and the maximum growth of P. fluorescens strain P17 from 5 to 50 micrograms acetate C per liter. AOC concentrations in various water samples were: biologically treated wastewater, 3.0-4.3 mg acetate C equivalent per liter; several rivers and lakes, 0.08-0.128 mg acetate C equivalent per liter; river water after bank filtration, 0.7-1.2 micrograms acetate C equivalent per liter; anaerobic groundwater, 6.8-9.0 micrograms acetate C equivalent per liter; and aerobic groundwater, 0-1.2 micrograms acetate C equivalent per liter. The percentage of AOC compared with total dissolved organic carbon ranged from 27% in the treated wastewater to < 1% in the bank filtered river water and groundwaters. AOC concentrations were determined at different stages of the water treatment process at four plants. These levels were increased by ozonation and decreased by dual media filtration, granular activated carbon adsorption, coagulation, and rapid filtration. Slow sand filtration had a minimal effect on AOC concentrations. The percentages of AOC in the total dissolved organic carbon were higher after the ozonation step (up to 6% in one plant) and < 1% after all other steps. Plasticized polyvinyl chloride water pipe released more AOC initially and after several weeks' incubation than polyethylene 25 and 50, silicone, and unplasticized polyvinyl chloride. (Cassar-FRC)
W83-02397

5G. Water Quality Control

A MODEL FOR MANAGING SOURCES OF GROUNDWATER POLLUTION,
Geological Survey, Menlo Park, CA.
S. M. Gorelick.
Water Resources Research, Vol 18, No 4, p 773-781, August, 1982. 7 Fig, 3 Tab, 20 Ref.

Descriptors: *Groundwater management, *Pollution control, *Groundwater pollution, *Model studies, *Water pollution control, Water supply, Water management, Water pollution sources, *Waste disposal.

The waste disposal capacity of a groundwater system can be maximized while maintaining water quality at specified locations by using a groundwater pollutant source management model that is based on linear programming and numerical simulation. The decision variables of the management model are solute waste disposal rates at various facilities distributed over space. A concentration response matrix is used in the management model to describe transient solute transport and is developed using U.S. Geological Survey solute transport simulation model. The management model was applied to a complex hypothetical groundwater system. Large-scale management models were formulated as dual linear programming problems to reduce numerical difficulties and computation time. Linear programming problems were solved using a numerically stable, available code. Optimal solutions to problems with successively longer management time horizons indicated that disposal schedules at some sites are relatively independent of the number of disposal periods. Optimal waste disposal schedules exhibited pulsing rather than constant disposal rates. Sensitivity analysis using parametric linear programming showed that a sharp reduction in total waste disposal potential occurs if disposal rates at any site are increased beyond their optimal values. (Baker-FRC)
W83-02161

CALCULATION OF POLLUTANT REMOVAL DURING GROUNDWATER RESTORATION WITH ADSORPTION AND ION EXCHANGE,
Texas Univ. at Austin. Dept. of Civil Engineering.
R. J. Charbeneau.
Water Resources Research, Vol 18, No 4, p 1117-1125, August, 1982. 6 Fig, 1 Tab, 18 Ref.

Descriptors: *Groundwater management, *Water pollution control, Ion exchange, Adsorption, Ammonium, Water quality, Leaching, Mining, Industrial wastes.

A simplified and computationally efficient method is presented for calculation of pollutant removal rates during groundwater restoration processes. The method is based on the condition that the influence of dispersion is frequently negligible and solves the resulting transport problem using the method of characteristics. The hydraulic information required by the method is obtained from conservative tracer breakthrough curve for a flow system. The influence of adsorption and ion exchange chemistry on species transport is included through application of the method of characteristics. The combined result gives the effluent concentration at a production well as a function of time during a restoration project. The method is applicable for any well pattern, and its economy is such that a pencil and paper calculation will suffice for yielding quantitative answers for complex flow problems. The method is applied to calculate ammonium removal rates for site restoration by recirculation with chemical sweeps following in situ leach mining of uranium. (Baker-FRC)
W83-02165

SYSTEMS ANALYSIS APPLIED TO THE PROTECTION AND ENHANCEMENT OF THE WATER QUALITY OF LAKE MACBRIDE,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
W. L. Paulson, and L. D. McMullen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177931, Price codes: A07 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute Publication No 79, Iowa State Univ., Ames, January 1983. 115 p, 41 Fig, 28 Tab, 82 Ref. OWRT A-051-IA(1), 14-34-0001-6016.

Descriptors: Lakes, Water quality, Eutrophication, *Iowa, Lake MacBride, *Systems analysis, Model studies, *Optimization, Land runoff, Agricultural watersheds, Eutrophic lakes, Simulation, Soil loss, Nitrogen, Phosphorus, Resource allocation model.

This study reports on the development of an optimization model to determine strategies for controlling the impact of land runoff on lake water quality. An Iowa agricultural watershed, and Lake MacBride were analyzed. It was found that the lake was a stratified eutrophic lake. Phosphorus was the limiting nutrient in early summer with nitrogen becoming limiting in the early fall. The nutrient input study indicated that 54% of the phosphorus and 91% of the nitrogen came from land runoff. Thirty six percent of the phosphorus came from the Solon wastewater treatment plant. With 75% compliance of good soil conservation, 77% of the phosphorus would come from Solon. A lake water quality simulation model, a watershed soil loss simulation model and a resource allocation optimization model were developed. The lake model simulated the water quality from May 1 to September 1. The soil loss model well represented soil loss in the basin utilizing 40 acre or less subdivisions. The optimization moden indicated that runoff control of up to 75% will result in enhanced water quality. The optional allocation of resources was $2 million in soil conservation plus nutrient removal at the wastewater treatment plant.
W83-02208

BIOLOGICAL TREATMENT OF ACID MINE DRAINAGE,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
E. E. Herricks.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178111, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Center Research Report No 173, Univ. of Illinois, Urbana-Champaign, October 1982. 87 p, 22 Fig, 8 Tab, 36 Ref. OWRT A-096-ILL(1), 14-34-0001-9015.

Descriptors: *Mine drainage, *Anaerobic digestion, *Biological treatment processes, *Sulfate reduction, Neutralization, *Wastewater treatment, Hydrogen ion concentration, Aeration, Settling.

Research was conducted to evaluate methods for the biological treatment of acid mine drainage (AMD). Two general approaches were evaluated. The first evaluated treatment of impounded AMD through the addition of a mixed microbial community and carbon sources appropriate for their maintenance. Several methods were attempted to provide suitable microbial communities, carbon sources, and environmental conditions suitable for continuous microbial activity. Wood dust and typical solid waste materials were shown to support sulfate reduction, but maintenance of sulfate reduction in AMD solutions was limited. In addition to wood dust and solid waste materials, sponge substrates were used to 'package' the microbial community in portable units which could be added to AMD impoundments. Sustained sulfate reduction was not obtained and water quality improvement was minimal. Most significant of the mechanisms was the potential for wood dust improvement of AMD quality when no biological activity was present. To provide adequate treatment of AMD, a second approach was directed to evauation of a biologically based unit process for AMD treatment. Using an anerobic digestor which provided waste liquors high in organic acids, AMD was mixed with digestor effluent in an anaerobic reactor which maintained sulfate reduction. The end result was production of an effluent with low iron concentrations and no detectable heavy metals with a pH in the range of 6.5 to 8.5. The utility of a pilot plant design incorporating anaerobic digestion, sulfate reduction, aeration, and final clarification and settling was demonstrated.
W83-02231

VIRAL CONTROL OF NUISANCE BLUE-GREEN ALGAE,
California Univ., Riverside. Dept. of Plant Pathology.
P. R. Desjardins, and G. B. Olson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178129, Price codes: A04 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, September 1982. 59 p, 13 Fig, 4 Tab, 65

Ref. (California Water Resources Center Project UCAL-WRC-W-533), OWRT A-066-CAL(1).

Descriptors: *Nuisance algae, *Algal control, *Viruses, *Bacteriophage, Algal blooms, Biocontrol, Algicides, *Cyanophyta.

Phage strain studies in the AS cyanophage group demonstrated that a supposedly new cyanophage was a serologically related strain of AS-1. Other studies in the Anabaena cyanophage group determined that the A-4 phage preparation, which was described as a temperate phage, was actually a mixture of a lytic and a temperate phage. In addition, Anabaena variabilis Strain S, originally isolated from soil, was found to be a new host for all three phages (A-1, A-4 and AN-10) used in the study. An antiserum to the LPP-1 cyanophage was prepared utilizing a highly purified preparation of the phage as antigen. The anitiserum, which had a relatively high titer (one lot-1:8192) was prepared for future detection of the cyanophage in water. Storage survival studies of species of both unicellular and filamentous cyanobacteria demonstrated that some species can survive for several months by simply freezing them at -20C in the culture growth medium. The fact that other species could only survive for relatively short periods under identical conditions indicates a need for further study on storage of cyanobacteria. Studies on the effects of freezing on AS-1 and LPP-1 cyanophages provided evidence for actual alteration of virion structure as well as significant decreases in the infectivity titers of the two cyanophages. In long term stability studies on AS-1 cyanophage we have found that the molarity of the buffer and the presence of MG++ions are critical for phage survival. This is of special interest since it was generally believed that this phage was very stable and had no requirement for mg++ ions.
W83-02232

METHOD OF CALCULATING A COMPLEX OF WATER CONSERVATION MEASURES IN THE CASE OF INTERBASIN WATER TRANSFER,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Moscow (USSR).
L. Ya. Anishchenko, F. V. Stol'berg, and G. A. Sukhorukov.
Water Resources, Vol 9, No 1, p 53-60, 1982. 1 Fig, 3 Tab, 9 Ref. Translated from Vodnye Resursy, No 1, p 94-101, January-February, 1982.

Descriptors: *Water transfer, Water management, *Water conservation, *Interbasin transfers, *Water quality control, Model studies, Economic aspects, Self-purification, Wastewater disposal, Rivers, Intakes, Planning, Canals, *USSR, Oka-Don-Oskol system.

A method was developed for calculating a complex of water conservation measures for regional interbasin transfer systems, accounting for processes of self-purification in rivers and allowing optimization of expenditures on water conservation when water users' requirements are fulfilled. Application to the Oka-Don-Oskol system illustrated the procedure. In this case the system was divided into 5 stretches. It was possible to develop a plan for the optimum start-up and sequence of proposed projects to simultaneously achieve the most economic water conservation measures and water quality objectives. The most economical location for an intake on the source river was also determined. (Cassar-FRC)
W83-02240

ACIDITY CONTROL IN THE NORTH BRANCH POTOMAC,
Interstate Commission on the Potomac River Basin, Rockville, MD.
D. P. Sheer, and D. C. Harris.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1441-1446, November, 1982. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Reservoir releases, *Neutralization, *Acid mine drainage, Effluents, Buffers, Water quality control, Alkalinity, Acidity, Water management, Wastewater treatment, Mine drainage, Savage River, *Potomac River, Bloomington Dam, Westernport, Maryland, West Virginia.

The impact of acid mine drainage on a 40 km rach of the North Branch of the Potomac River will be lessened by construction of the Bloomington Dam and by discharge of highly buffered, alkaline effluent from the Westvaco Corporation's pulp and paper mill through the Westernport municipal treatment plant. The treatment plant exerts a neutralizing effect of 13.6 metric tons of CaC03 per day. A reservoir operating policy was developed to average the acid releases within minimum flow, water supply, and flood control requirements. This can be attained by making maximum use of the alkaline treatment plant effluent, maintaining the highest possible pH at the reservoir bottom, and maintaining sufficient water capacity to dilute occasional highly acidic inflows. An equation for determining the neutralization requirement (moles of bicarbonate needed to raise a particular volume of reservoir water to a target pH) depends on the flow, alkalinity, and the time of reservoir releases for both the Potomac and the Savage River. (Cassar-FRC)
W83-02259

THE DISTRICT OF COLUMBIA WATER RESOURCES RELATED ACTIVITIES 1980-1981,
District of Columbia Univ., Washington. Water Resources Research Center.
M. H. Watt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-180307, Price codes: A04 in paper copy, A01 in microfiche. District of Columbia Water Resources Research Center Report No 38, December 1981. 41 p, 8 Fig, 11 Tab, 2 Append. OWRT A-999-DC(3), 14-34-0001-0109.

Descriptors: *Federal government, *District of Columbia, *Inter-agency cooperation, *Local government, *Regional planning, *Water supply, Drought simulation, *Sludge disposal, Resources allocation, Urbanization, Short term planning, Long term planning, Interstate commission, Urban runoff, *Water pollution control.

This report is a summary of events which have taken place in water resources in Washington, D.C. During the years 1980 and 1981 much has been done in water and water related activities. This report addresses the critical water management issues in the District of Columbia, namely, the sludge disposal management, and the regional metropolitan Washington cooperation for water supply. Important studies and projects concerning the District of Columbia five year strategy for wqter pollution control, non-point source pollution, cooperative water supply operations on the Potomac, and the Blue Plains Feasibility Studies are described. Brief summaries of other major studies on the upper Potomac estuary and the related water quality models were given. For each activity, the status and the major agencies involved were provided. The Part II of the report is a statistical update of the meteorological, water quality, water supply, wastewater flows, organic loading, and population characteristics data.
W83-02293

LAKE MERRITT RESTORATION PROJECT, FINAL REPORT,
R. W. Hofmann, and G. W. Shawley.
California State Water Resources Control Board, Publication No 82-5TS, Sacramento, January 1982. 129 p, 32 Fig, 21 Tab, 21 Ref, 8 Append.

Descriptors: *Lake restoration, *Rehabilitation, *Algal growth, *Nuisance algae, *Aquatic weeds, *Dredging, Riprap, Nutrient removal, Sediment control, Aeration, Oxygenation, Water level, Water depth, Aquatic weed control, Cost-benefit analysis.

Lake Merritt, in Oakland, Calif., is used for flood control, fisheries and wildlife habitat, recreation and aesthetic appreciation; however, it has water quality problems such as nuisance growths of algae and widgeon grass. The objective of this project is to develop rehabilitation stragegies which would lead to complete or near-complete restoration and enhancement of the lake. Single rehabilitation actions will not restore the lake to the standards desired; some single methods excluded were nutrient removal/inactivation, sediment traps, controlling input sources, bottom dragging and aeration. The remaining single rehabilitation methods--harvesting, water level control, herbicides, riprapping, minor and major dredging--have been combined into seven strategies which will provide varying levels of restoration to and enhancement of the lake. The Reactive approach would only react to growths by harvesting, and the Modified Reactive approach would harvest growths but not solve the causes of growths; therefore, these methods were excluded. An aquatic weed inhibition strategy would require ongoing use of herbicides and use of an oxygenation system, so is not a favored approach. Intermediate rehabilitation and full rehabilitation without dredging Area VIII also have drawbacks. Full rehabilitation is the favored and most permanent solution. It includes major dredging and riprapping the shoreline shelf. Harvesting would only be needed occasionally and minimal managment would be required. Funding requirements might favor staged full rehabilitation over nine years, which would have the same end results but with slower immediate solutions. (Atkins-Omniplan)
W83-02298

THE KELP FORESTS OF PALOS VERDES PENINSULA 1982,
California State Dept. of Fish and Game, Sacramento.
For primary bibliographic entry see Field 5C.
W83-02304

WATER QUALITY MANAGEMENT STUDIES, LAKE SEMINOLE, FEBRUARY-DECEMBER 1979, PHASE II.
Water and Air Research, Inc., Gainesville, FL.
Army Corps of Engineers, Mobile District Technical Report ACF 80-11, December 1982. 653 p 4 Fig, 20 Tab, 86 Ref, 15 Append. DACW01-78-C-0101.

Descriptors: *Water quality, *Reservoirs, *Turbidity, *Aquatic plants, *Aquatic animals, *Bacteria, *Lake Seminole, Sediments, Nutrients, Productivity, Algae, Zooplankton, Invertebrates, Alkalinity, Specific conductance, Dissolved solids, Hydrology, *Florida, *Georgia, Alabama.

Meteorological, hydrological, water quality, sediment, and biological data were obtained at a total of 19 main sampling stations in Lake Seminole, the Chattahoochee River, the Flint River, Spring Creek, Fish Pond Drain, and the Apalachicola River during Phase II. Average monthly flows through the impoundment during Phase II ranged from 349 cu m/s during August to 1518 cu m/s during April. As a result of operational procedures at the Walter F. George Lock and Dam, flows through Chattahoochee River impoundment arm exhibited considerable short term variation. Each of the major impoundment arms of Lake Seminole tended to be well-mixed both laterally and vertically. Average turbidity levels in the Chattahoochee River were approximately two to three times those in the Flint River. Specific conductance, total dissolved solids, and alkalinity were lowest at the Chattahoochee River sites and generally higher on the Flint River. Based on nutrient content, the waters of Lake Seminole tended to be moderate to highly productive with respect to the production of algal biomass. At stations 16 and 17 on the Flint river, phytoplankton and zooplankton densities were unusually low. The bacteriological quality in Lake Seminole ranged from good in the upper Chattahoochee River stations and at the lake stations to poor at station 17 in the Flint River. Bottom sediments ranged from relatively clean sands in the rivers to sand and sandy loams in the impoundment itself. Benthic macroinvertebrate populations tended to be closely associated with the nature of the substrate. Emergent and floating aquatic macrophytes covered over 40% of the total reservoir surface area. (Moore-SRC)
W83-02312

URBAN PLANNING CRITERIA FOR NON-POINT SOURCE WATER POLLUTION CONTROL,
Catholic Univ. of America, Washington, DC. Dept. of Civil Engineering.
G. K. Young, and D. L. Danner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182261, Price codes: A09 in paper copy, A01 in microfiche. D.C. Water Resources Research Center Report No 35, Univ. of the District of Columbia, March 1982. 163 p, 21 Fig, 14 Tab, 45 Ref, 2 Append. OWRT A-009-DC(1), 14-34-001-1109.

Descriptors: *Water pollution, *Urban hydrology, *Water quality modeling, Planning criteria, In-line storage, Stormwater detention, Sewer separation, Street sweeping, Sewer flushing, Wastewater treatment, Best management practices, *Nonpoint pollution sources.

The research described in this document couples urban storm runoff quality and control alternatives within the context of an urban sewerage system to evaluate various combinations of alternatives through their pollution removal efficiencies and their costs. A model has been developed which simulates the response of a typical urban area to a time series of rainfall events, and which uses the District of Columbia as an example. The modeling of the flow of runoff and sewage has been performed at a macro level; the control alternatives examined include in-line storage, sewer separation, street sweeping, sewer flushing, stormwater detention, and increased treatment capacity. Each pollution abatement measure is described with a pollution function, a pollution removal function, and a cost function. The simulation model with its associated decision criterion was validated against actual water quality data for Washington, D.C. The model demonstrates that a macro approach to cost/benefit analysis of non-point source water pollution can evaluate control tradeoffs in terms of cost or in terms of abatement effectiveness. The importance of the developed methodology is that it provides an accurate estimate of urban pollution loads, pollution control capabilities, and control costs without requiring complex graphical techniques or large, explicit simulations. The user is not required to supply any technical or specialized information to run the model; the only inputs to the model are readily available physical characteristics of the urban area.
W83-02317

MICROBIOLOGICAL CONTROL OF THE AQUATIC WEED, MYRIOPHYLLUM SPP,
Massachusetts Univ., Amherst. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 4A.
W83-02321

ALBEMARLE SOUND - TRENDS AND MANAGEMENT NEEDS.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181990, Price codes: A05 in paper copy, A01 in microfiche. Proceedings, Conference at the College of the Albemarle, Elizabeth City, NC, March 3, 1982. Univ. of North Carolina Water Resources Institute, Publication UNC-WRRI-82-178, Raleigh, April 1982. 92 p, (11 Papers), 1 Append. OWRT A-999-NC(56).

Descriptors: *Water quality, *Coastal waters, Coastal streams, Algae, Nutrients, Fish diseases, Fisheries, Saline-freshwater interfaces, *Albemarle sound, Eutrophication, *Algal blooms, Cyanophyta, *Brackish water, Water pollution effects, Chowan River, *North Carolina.

A conference was held March 3, 1982, to focus on the water quality in the rivers and sounds of the Albemarle region with special emphasis on the Albemarle Sound. The Sound and its associated tributary estuaries represent a vast complex of fresh to brackish-water creeks, rivers, and open-water sounds constitute a significant portion of the North Carolina coastal system. Major presentations in the Conference included: a historical perspective of the Albemarle Sound, its economic and social importance, its ecology and physical characteristics, an overview of the current water quality study plan, environmental factors causing blue-green algal blooms in the Chowan River fisheries production in the Sound, and agricultural resources and trends of the region. A North Carolina legislative study commission reviewing the problems and needs of the Chowan River and Albemarle Sound is expected to make recommendations to the 1983 General Assembly for long-term studies and action plans to improve water quality and fisheries in these waters.
W83-02325

EFFECT OF HYDRILLA-GROWTH INHIBITING EXTRACTS UPON THE GROWTH OF SCENEDESMUS OBLIQUUS,
University of South Florida, Tampa. Dept. of Biology.
P. M. Dooris, W. S. Silver, and D. M. Martin.
Journal of Environmental Science and Health, Part A, Vol 17, No 5, p 639-645, 1982. 3 Fig, 9 Ref.

Descriptors: *Weed control, *Algae, *Hydrilla, *Aquatic weed control, Growth, Plant growth, Inhibition, Scenedesmus obliquus, Lake Starvation, *Florida, Lake sediments, Submerged plants, Herbicides.

A hydrilla growth inhibitor extracted from the sediments of Lake Starvation, Florida, did not inhibit growth of fresh water alga Scenedesmus obliquus at concentrations inhibitory to hydrilla, 0.4 ppm organic carbon. Algae cultures were stimulated at levels of 6-12 ppm organic carbon and were inhibited at 18 ppm organic carbon and 0.01 ppm Fe. Sediments in Lake Starvation are derived principally from degradation of bald cypress organic matter. The dark-colored active fraction loses its activity upon anion exchange resin treatment but upon cation exchange resin treatment. Infrared spectra indicate a complex polyphenolic composition. (Cassar-FRC)
W83-02358

GROUNDWATER POLLUTION: A CASE STUDY,
Waterloo Regional Municipality (Ontario). Marshland Centre.
J. D. Pawley.
Journal of the American Water Works Association, Vol 74, No 8, p 405-407, August, 1982. 2 Fig.

Descriptors: *Groundwater pollution, *Case studies, *Oil recovery, *Oil pollution, *Oily water, Industrial wastes, Water pollution, Aquifers, Streams, Phenol, Chloride, Sulfates, Monitoring, Drinking water, Waterloo, *Ontario, Canada.

A case study is presented of groundwater pollution caused by acid sludge discarded by an oil recovery plant into a series of lagoons near Waterloo, Ontario, Canada. The lagoons were later filled with native material, and now the waste is leaching laterally into a pond and stream as well as downward to the aquifer. Induced infiltration drinking water wells terminate in this aquifer. Actions taken to date include monthly sampling of phenol, chloride, and sulfate levels, a steel liner to separate the stream from the lower aquifer, and diversion of upstream water around the leachate pond. An in-depth study of the contamination problem has also been undertaken. A long-term, cost-effective solution has not yet been found. (Small-FRC)
W83-02378

ALTERNATIVES FOR CONTROLLING ORGANICS IN GROUNDWATER SUPPLIES,
Pirnie (Malcolm), Inc., Paramus, NJ.
J. E. Dyksen, and A. F. Hess, III.
Journal of the American Water Works Association, Vol 74, No 8, p 394-403, August, 1982. 9 Fig, 4 Tab, 15 Ref.

Descriptors: *Groundwater pollution, *Organic compounds, *Land disposal, Water pollution effects, Aeration, Adsorption, Activated carbon, Resins, Water treatment, Water pollution.

Source control and water treatment techniques for controlling organics in groundwater supplies are discussed. In each of 24 states, at least one community has detected one or more synthetic organic compounds in its groundwater supply. A major source of organics is land disposal of domestic and industrial wastewater and solid wastes. Management techniques for control of organics include elimination of the source, location of a new water source, and blending of existing water sources. Treatment techniques include aeration, adsorption and combined control strategies. Management techniques have the lowest cost. Three adsorption techniques: granular activated carbon, powdered activated carbon, and synthetic resins, have received much attention in the United States for the treatment of large surface water supplies. (Small-FRC)
W83-02385

PLANNING FRAMEWORK AND MODELLING OF WATER QUALITY FROM RAINFED AGRICULTURAL LANDS,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
G. V. Skogerboe.
Water Supply and Management, Vol 6, No 5, p 359-374, 1982. 6 Fig, 9 Ref.

Descriptors: *Water quality control, *Agricultural watersheds, *Nonpoint pollution sources, Planning, Model studies, Fate of pollutants, Water pollution sources, Watershed management, Sediments, Nutrients, Pesticides, Management, Monitoring.

A framework for planning a water quality control program for receiving waters in agricultural watersheds is described. It consists of three phases: (1) identification of agricultural nonpoint source water quality problems, (2) development of best management practices (BMP), and (3) implementation of BMP. Problems may be identified by monitoring the receiving water and determining the impact of any pollutant. Pollution sources and their magnitude are determined. The significance of agricultural pollutants with respect to overall pollution from natural sources, point sources, and other nonpoint sources is determined. BMP's are developed by investigating available methods and determining their applicability to the watershed in question. This may involve collection of field data and determination of cost effectiveness. Several models are available to assess the fate of sediments, salts, nutrients, and pesticides, notably the Universal Soil Loss Equation, the Agricultural Runoff Management (ARM) model, Cornell models for Nutrient Simulation (CNS) and pesticides (CPM), and simulation of soil moisture and chemistry. The success of a chosen watershed management method depends on farmers' acceptance. Implementation of BMP's is not discussed in detail. (Cassar-FRC)
W83-02392

FACILITATION OF COMMUNITY ORGANIZATION,
Research Triangle Inst., Research Triangle Park, NC.
For primary bibliographic entry see Field 6B.
W83-02395

NUCLEAR POWER REACTOR ACCIDENTS AND THE ROLE OF WATER SYSTEM MANAGERS,
S. Davies, and J. C. Bumstead.
Journal of the American Water Works Association, Vol 74, No 8, p 382-390, August, 1982. 8 Fig, 7 Tab, 17 Ref.

Descriptors: *Radioactivity, *Radioactivity effects, *Nuclear powerplants, *Nuclear reactors, *Hazards, *Management planning, Planning, Accidents, Water pollution, Water supply, Iodine, Strontium, Cesium.

As a guide to water system managers preparing for the remote possibility of nuclear reactor accidents, technical formation is presented on the release of radioactivity. Operable and compatible emergency response plans should be developed if a release would be likely to contaminate a public water source. Water sources located within the 16.1 km Emergency Planning Zones must be maintained

and operated during radiation accidents. Federal, state, and local agencies will work closely with managers in the evaluation of contamination and the planning of protective actions to protect the public. Potential doses of radioactive materials including iodine, strontium, and cesium, are quantified. Remedial actions which could be taken by water system managers include sheltering and evacuation of people and development of emergency measures to restrict ingestion of contaminated waters. (Small-FRC)
W83-02398

ECONOMIC POTENTIALS FOR MANAGING NUTRIENT LOSS WITH ALTERNATIVE IRRIGATION TECHNOLOGIES,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 6F.
W83-02403

MEMORANDUM OF EVIDENCE TO THE ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION,
H. R. Evans.
Water Pollution Control, Vol 81, No 4, p 566-569, 1982.

Descriptors: *Water pollution control, *Sludge disposal, *Wastewater treatment, Land application, Cadmium, Monitoring, Odor control, Coastal water, Plastics, Nonpoint pollution sources, *United Kingdom.

The Institute of Water Pollution Control submitted a number of views to the Royal Commission on Environmental Pollution. Sludge utilization policies support development of guidelines for sludge disposal on land, the elimination of Cd plating or pretreatment of Cd wastes, and sludge analyses for toxic materials and pathogens. Sewage treatment authorities should have the power to constrain housing development on the boundaries of the plant to prevent odor complaints, since odor control measures in the plant are very expensive. The chemical composition of proprietary materials discharged into sewers should be readily available to pollution control authorities. Caution is urged on immediate implementation of the legislation controlling pollution in coastal waters in the absence of specific pollution problems. The Institute recommends that sewage plant discharges should be monitored by a neutral party, not by the plant generating the effluent. Problems of nonbiodegradable plastics in sewage are stressed. Concerns about nonpoint source pollution include agricultural chemicals, fish farms, leachates, acid rainfall, and afforestation. (Cassar-FRC)
W83-02425

RIVER BASIN MANAGEMENT IN AN INDUSTRIAL AREA,
Yorkshire Water Authority (England).
H. B. Tench.
Water Pollution Control, Vol 81, No 4, p 511-524, 1982. 2 Fig, 3 Tab, 5 Ref.

Descriptors: *Water pollution control, Industrial wastes, Mine drainage, Yorkshire Water Authority, Don River, River basins, Water management, Management, Costs, Economic aspects, Model studies, Effluents, *England.

Changes in management of the River Don basin, England, since the formation of water authorities in 1974 are described. Major pollution problems in this industrial area are coal carbonizing plant effluents, paper mill discharges, coal mine drainage, municipal effluents, and combined sewer overflows. The reorganized management is based on 3 river basin areas, Don, Dearne, and Rother, rather than the 4 large towns. Cost saving measures have held the rise in costs to 4% from 1977 to 1980 in spite of 2 new plants. There has been no improvement in effluents from works serving under 1000 population. Effluent BOD averaged 57 mg per liter for works serving under 200 people and 30 mg per liter for works serving 200-1000 people. Larger works produced effluent BOD of 16-18 mg per liter. There are essentially no fish in the Don and its associated streams except in the headwaters. The Rother is one of the country's most polluted rivers. Models for determining acceptable pollutant loads in wet and dry weather are described. Improvement in river quality are hampered by lack of capital funds and lack of legislation to control mine drainage. (Cassar-FRC)
W83-02432

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

INTERACTIVE MODELING AND DATA MANAGEMENT FOR PREDICTING SURFACE AND GROUNDWATER QUALITY AND QUANTITY,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
D. P. Loucks, and J. R. Stedinger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173211, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, January 1983. 24 p, 5 Fig, 27 Ref. OWRT A-092-NY(1), 14-31-0001-1134.

Descriptors: *Surface-groundwater relations, *Computer models, *Simulation analyses, *Water management, Water quality, *Interactive computer graphics, Systems analysis, Hydrologic systems, *Graphic display, Groundwater contamination, Decision making.

This report outlines an approach to the study of coupled surface and groundwater systems. It reports on the progress of one-year exploratory research project on the development of methods for linking various models and data together, interactively, to enable the prediction and study of regional water quantity and quality problems. Interactive computer graphics are used to facilitate spatial data input, editing and display, and for model management and sequencing. The methods developed and planned in this project are being adopted for implementation on portable microcomputers having sufficient memory, disk storage and speed to enable the use and display of videodigitized maps and other data requiring high spatial and color resolution. Special emphasis is given to the implementation of this methodology by those involved in the process of planning, recommending policy, or decision making. Once developed, the methodology will be applied to a number of existing groundwater contamination problems in cooperation with Cornell University Extension personnel and individuals in other organizations in the U.S. and abroad.
W83-02130

OPTIMAL REAL-TIME RESERVOIR SYSTEMS OPERATION: INNOVATIVE OBJECTIVES AND IMPLEMENTATION PROBLEMS,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 4A.
W83-02142

CLUSTER MODEL FOR FLOOD PEAK ANALYSIS: APPLICATION TO LOWER OHIO RIVER BASIN,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 2E.
W83-02143

DYNAMIC PROGRAMMING APPLICATIONS IN WATER RESOURCES,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
S. Yakowitz.
Water Resources Research, Vol 18, No 4, p 673-696, August, 1982. 8 Fig, 6 Tab, 135 Ref.

Descriptors: Water resources development, Computers, *Reviews, *Dynamic programming, *Stochastic process, Probabilistic process, *Mathematical studies, Hydrologic models, *Model studies, Water quality, Irrigation, Reservoirs.

This survey reviews dynamic programming models for water resource problems and examines computational techniques which have been used to obtain solutions to these problems. Problem areas surveyed include aqueduct design, irrigation system control, project development, water quality maintenance, and reservoir operations analysis. Computational considerations impose severe limitations on the scale of dynamic programming problems which can be solved. Inventive numerical techniques for implementing dynamic programming have been applied to water resource problems. Discrete dynamic programming, differential dynamic programming, state incremental dynamic programming, and Howard's policy iteration method are among the techniques reviewed. Attempts were made to delineat the successful applications, and speculative ideas are offered toward attacking problems which have not been satisfactorily solved. (Baker-FRC)
W83-02147

PLANNING WATER REUSE: DEVELOPMENT OF REUSE THEORY AND THE INPUT-OUTPUT MODEL, VOL I: FUNDAMENTALS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
C. D. Turner, and D. W. Hendricks.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175216, Price codes: A14 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Completion Report No 114, Colorado State University, Fort Collins, September 1980. 316 p, 45 Fig, 39 Tab, 97 Ref. OWRT C-80202-R(8818)(1), 14-34-0001-8818.

Descriptors: *Water reuse, *Municipal water, *Water plans, Water demand, Water law, Water transfer, *Colorado, Denver, Fort Collins, South Platte River, Basin, *Potable water, Public health, Treatment facilities, Model studies, *Input-output analysis, Water quality.

Municipalities in the west are searching for new sources of water at a time when very little undeveloped water remains. An increasing number of communities are planning to meet growing water needs through water reuse. In Denver, for example, a potable water reuse facility of 100 mgd is being planned for construction during the 1990's. An alternative to potable water reuse is the exchange of treated municipal wastewater for unused high-quality agricultural water. This type of water reuse promises to be less expensive than potable reuse, and it can be implemented today. In order to facilitate the exploration of municipal water reuse alternatives, a water reuse methodology is developed in the research. Two case study demonstrations are used to document the application of the methodology. The water reuse planning methodology is developed using: (1) a synthesis of reuse definitions from the literature; (2) an analysis of proposed and existing water reuse projects to discover new directions in reuse development; (3) identification of financial and regulatory incentives contained in the water quality laws; and (4) the identification of mechanisms in appropriative water law that influence water reuse. The resulting methodology is designed to aid in the formulation of water reuse alternatives. An economic methodology is also developed for the evaluation and comparison of dual purpose water reuse alternatives with other water supply and wastewater treatment alternatives. The South Platte River Basin and the cities of Fort Collins and Greeley are used to demonstrate the alternative development methodology. The demonstration shows that water reuse exchange with agriculture has the potential to meet all but the very highest municipal water projections for the next 40 years in the basin.
W83-02176

PLANNING WATER REUSE: DEVELOPMENT OF REUSE THEORY AND THE INPUT-OUTPUT MODEL, VOL II: APPLICATION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
D. Klooz, and D. W. Hendricks.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175224,

Price codes: A08 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Completion Report No 115, Colorado State University, Fort Collins, September 1980. 154 p, 19 Fig, 5 Tab, 26 Ref, 2 Append. OWRT C-80202-R(No. 8818)(1), 14-34-0001-8818.

Descriptors: *Water reuse, *Municipal water, *Water plans, Water law, *Water transfer, *Colorado, South Platte River Basin, Water quality, *Input-output analysis, *Water demand, Model studies, Drought, Cache la Poudre River basin.

In order to facilitate the exploration of municipal water reuse alternatives, a water reuse methodology and an input-output water balance model have been developed in the research. Case study demonstrations in the South Platte River Basin of Colorado are used to document the application of the methodology and the input-output water balance model. Volume I of the research develops the reuse planning methodology and applies the methodology in two case studies. The water reuse planning methodology is based on: (1) a synthesis of reuse definitions from the literature; (2) an analysis of proposed and existing water reuse projects to discover new directions in reuse development; (3) identification of financial and regulatory incentives contained in the water quality laws; and (4) the identification of mechanisms in appropriative water laws that influence water reuse. Volume II adapts basic input-output principles to the context of reuse in a water resources system. The depiction of water reuse by this methodology is based on two reuse schemes. One scheme focuses on the various reuse forms employed in a river basin. The other one depicts the water quality of the transferred and reused water and the water quality requirements of the use systems.
W83-02177

ESTIMATION OF GROUNDWATER RESOURCES ON THE BASIS OF DECISION-MAKING THEORY,
Akademiya Nauk Moldavskoi SSR, Kishinev. Inst. of Geophysics and Geology.
For primary bibliographic entry see Field 4B.
W83-02252

LARGE-SAMPLE METHODS FOR DECISION ANALYSIS OF GAMMA VARIATES,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
R. Krzysztofowicz, and S. Yakowitz.
Water Resources Research, Vol 16, No 3, p 491-500, June, 1980. 9 Fig, 6 Tab, 15 Ref.

Descriptors: *Statistical analysis, *Rainfall, *Decision making, *Bayes decision theory, *Gamma variables, Planning, Water management, *Arizona, Tucson.

Although the Bayes decision techniques are used for water resource management problems and the gamma variable is used to study hydrological phenomena, their concurrent use leads to computational difficulties. This paper shows how the problems may be circumvented by use of likelihood approximation techniques from optimal decision theory in conjunction with certain expansion formulas to obtain a multivariate normal approximation to the posterior law. The contour curves of the normal law are ellipses and are better suited to computer simulation than the exact posterior law. With moderate size data sets the approximate posterior is almost equivalent to the actual law. Examples analyzed were derived from winter rainfall data from Tucson, Arizona. (Cassar-FRC)
W83-02274

MULTIOBJECTIVE ANALYSIS OF MULTIRESERVOIR OPERATIONS,
California Univ., Los Angeles. School of Engineering and Applied Science.
W. W-G. Yeh, and L. Becker.
Water Resources Research, Vol 18, No 5, p 1326-1336, October, 1982. 9 Fig, 2 Tab, 33 Ref.

Descriptors: *Multiobjective planning, *Reservoir operation, *Operating policies, Multireservoir networks, Multipurpose projects, Water management, Planning, Benefits, *California Central Valley Project, Optimization, Decision making.

Practical procedure for analyzing a multiple purpose, multiple facility reservoir system were developed for the purpose of optimizing system operation. In this study the 5 purposes or benefits treated as objectives were hydropower production, fish protection, water quality maintenance, water supply, and recreation. The constraint method was used to develop trade-offs and a specially modified linear programming and dynamic programming algorithm. The procedures were applied to the California Central Valley Project (9 storage reservoirs, 3 canals, 4 pumping plants, and 9 powerplants). Noninferior sets were obtained with each benefit parameterized singly and in various combinations. Two sets of monthly streamflows (one for a drought year and the other for an excess water year) were used to develop the corresponding noninferior sets. These procedures helped to allocate total benefits derived from the water resource and to operate the system with all constraints. This technique permitted a very high degree of decomposition of the noninferior policy set. Information was presented in a series of two-dimensional plots representing cross sections of the noninferior set. (Cassar-FRC)
W83-02348

MANAGING WATER RESOURCE SYSTEMS,
National Inst. for Training in Industrial Engineering, Bombay (India).
R. P. Mohanty.
Water Supply and Management, Vol 6, No 5, p 387-403, 1982. 4 Fig, 36 Ref.

Descriptors: *Systems analysis, *Water management, Management, Model studies, *Alternative planning, Long-term planning, *Management planning, Water resources development, Economic aspects, Social aspects, Decision making, Legal aspects.

A general model for management of water resource systems is proposed. The five constraining forces are external, process, technical, performance, and organizational. External constraints include the socioeconomic situation, political structure, public policies, legal system, cultural factors, and demand generating systems. For example, in very affluent communities and politically underdeveloped countries, management policies change very rapidly. An equilibrium policy is characteristic of a moderately affluent economy. Process constraints are inherent in the managerial functions. Technical constraints are imposed by technical and physical configuration of the system, for example, topographic conditions and agro-climatic conditions. Performance constraints arise from the standards against which system effectiveness are evaluated, such as economic efficiency or quality of life. Organizational constriants originate from conflicts among the different groups in the water resource organization: users, government, and production sector. Use of this model allows consideration of the dynamic and strategic issues and is appropriate for planning long-term growth. Traditional systems analysis techniques produce a series of alternative engineering estimates and do not resolve many of the diverse social and technical issues. (Cassar-FRC)
W83-02379

DEVELOPMENT AND OPERATIONAL STRATEGIES FOR WATER RESOURCE AND SUPPLY SYSTEMS,
T. Kitson.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 4, p 257-273, 1982. 5 Fig, 1 Tab, 34 Ref.

Descriptors: *Water demand, *Water management, *Water supply, Severn-Trent Water Authority, Model studies, Hydrologic models, Planning, Operating policies, Data collections, Water policy, Peak demand, Water use, Water storage, Water resources development, Reservoirs, Rivers, Groundwater, *England.

The present state of the art regarding practices and techniques used in water resource/supply analysis in the United Kingdom, in particular by the Severn-Trent (ST) Water Authority, is described. Basic data requirements for planning and day to day control, development strategy, factors influencing operational thinking in the 1980's are discussed. The academic aspect of time series information has developed to a greater degree than practical applications. ST uses a 15 station data bank containing records from 1932 to the present. Real-time flow forecasting models are under consideration. Water demand data was estimated by simple trend projection of total supply output prior to 1974. Forecasts are now based on newer methods which consider household, industrial-commercial-agriculture, and transmission loss and use and on the factors affecting use: weather and season. The analysis of the water system is based on a hierarchy of geographical units, dependent on access to water supply (Severn, river; East Midlands, reservoirs; and Upper Trent, groundwater). For modeling work 3 capacity parameters have been defined: maximum value that can be sustained for 3 or 4 weeks, a normal value that can be sustained for months, and minimum capacity. Proposed water storage schemes (Carsington Reservoir and Shropshire groundwater field) will increase the flexibility of water supplies. Interlinking among sources provides security in case of drought or short-term failure and increases efficiency in meeting demand. At present most links are on the local level. Rules for operating all strategic reservoir and river sources have been developed. ST has formulated standards for water resource/supply reliability. (Cassar-FRC)
W83-02387

6B. Evaluation Process

VALUATION AND ACQUISITION OF FLOODPLAIN LANDS FOR STREAM VALLEY PARKS,
Georgia Univ., Athens. Coll. of Business Administration.
For primary bibliographic entry see Field 6F.
W83-02140

SUPPLEMENTAL IRRIGATION OF HORTICULTURAL CROPS IN THE HUMID REGION,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W83-02172

COMPUTER-OPTIMIZED STORMWATER TREATMENT (COST) PROGRAM: PHILADELPHIA CASE STUDY,
CH2M/Hill, Gainesville, FL.
U. P. Singh, J. E. Scholl, and R. L. Wycoff.
Water Resources Bulletin, Vol 18, No 5, p 769-778, October, 1982. 8 Fig, 5 Tab, 9 Ref.

Descriptors: *Combined sewer overflows, *Storm wastewater, *Pollution load, Model studies, Water quality control, Wastewater treatment, Planning, Urban runoff, Runoff, Economic evaluation, Dissolved oxygen, Oxygen, Philadelphia, *Pennsylvania, Optimization, Water pollution control, Biological oxygen demand.

Two computer models, the Continuous Stormwater Pollution Simulation System (CPSS) and the Computer Optimized Stormwater Treatment Program (COST), were applied to the Philadelphia, Pennsylvania, urban area to aid in water quality planning. Results indicated that removing 5 million pounds of BOD from combined sewer overflows would reduce low dissolved oxygen events by the Delaware River Estuary by 107 hours per year; and removing 5 million pounds of BOD from storm water runoff, by 56 hours per year. Upstream flow (70 million pounds BOD per year) and wastewater effluents (60 million pounds BOD per year) account for the major portion of the 178 million pounds per year of BOD load. THe COST program provides a planning and conceptual design tool to identify the economically optimum combination of wet weather and dry weather po[l]

lution abatement alternatives. CSPSS is a water quality model which relates pollutant loads to receiving water impacts. Selection of a water pollution control strategy can be based on evaluating the tradeoffs between total annual costs and receiving water improvements. (Cassar-FRC)
W83-02174

AN EVALUATION OF WATER CONSERVATION TECHNIQUES IN THE UPPER COLORADO RIVER BASIN,
Utah Water Research Lab., Logan.
R. Narayanan, and D. R. Franklin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175315, Price codes: A03 in paper copy, A01 in microfiche. Utah Water Research Laboratory Water Resources Planning Series UWRL/P-82/07, December 1982. 39 p, 4 Fig, 25 Tab, 30 Ref. OWRT B-185-UT(1), 14-34-0001-9137.

Descriptors: *Water conservation, *Colorado River, *Salinity standards, *Water quality standards, *Economic evaluation, Fossil fuels, Irrigation demand, *Water allocation, *Water demand, Cost-benefit analysis, Industrial potential.

The Upper Colorado River Basin contains large deposits of oil shale, tar sands, crude oil, coal, and natural gas. Agriculture still accounts for 90% of the water depletions, but future development of these energy resources is expected to take increasing amounts of water. A mixed-integer programming model was used to maximize returns to land, water, and mineral resources. The results were used to assess the need for government-sponsored water conservation measures to supplement water saving techniques employed by the private sectors in response to increased water prices. The feasibilities of various water saving techniques by industries and of various government-sponsored water conservation measures were examined within a benefit-cost analysis framework. The model is solved for 1974 data and for 1985 and 2000 with assumed water demand increases. The solutions indicate that public investments in water conservation measures are not economically justified by the water saved since the marginal value of water is less than the cost of conservation. However, where consequent reductions in downstream salinity levels are taken into consideration, the benefits exceed the cost of various conservation programs. However, even these benefits are insufficient to justify expanding the salinity control program to the level required to achieve EPA salinity standards.
W83-02186

ENERGY IMPACTS OF WATER BASED RECREATION,
Utah Water Research Lab., Logan.
J. C. Batty, D. A. Bell, E. B. Godfrey, C. Howell, and J. P. Riley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178152, Price codes: A04 in paper copy, A01 in microfiche. Utah Water Research Laboratory Water Resources Planning Series UWRL/P-82/09, December 1982. 46 p, 11 Fig, 12 Tab, 110 Ref, 1 Append. OWRT B-171-UT(1), 14-34-0001-9137.

Descriptors: Water resources development, Water management, *Energy, *Recreation demand, *Economic aspects, Planning, *Accounting, *Utah, Lake Powell.

The overall objective of the study reported here was to determine to what extent energy accounting could supplement and/or complement economic benefit/cost analyses of water management projects and to specifically examine the energy impacts of water based recreation. The energy accounting literature was carefully reviewed and an energy accounting methodology applicable to water management was devised. Data pertaining to recreation at five reservoirs in Utah were assembled from visitation records and on-site surveys. Energy requirements for site construction, travel to and from the recreation site, and recreation at the site were estimated. It was determined that energy devoted to water based recreation is not inconsequential. As much energy is devoted to recreation at Lake Powell alone as is required for all production agriculture in Utah. It is suggested that while the models developed in this study could be used with confidence in the preparation of energy impact statements the authors are not persuaded energy accounting provides additional information to water use planners beyond that obtainable from traditional economic analysis.
W83-02235

URBAN PLANNING CRITERIA FOR NON-POINT SOURCE WATER POLLUTION CONTROL,
Catholic Univ. of America, Washington, DC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W83-02317

ASSESSMENT OF THE STATE OF THE ART AND DEVELOPMENT OF PROPOSED IMPROVEMENTS IN RECREATION BENEFIT VALUATION FOR WATER RESOURCES PLANNING,
George Washington Univ., Washington, DC. Dept. of Engineering Administration.
R. C. Waters, and V. S. Moustakis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181974, Price codes: A03 in paper copy, A01 in microfiche. D.C. Water Resources Research Center Report No 43, Univ. of the District of Columbia, February 1983. 24 p, 22 Ref. OWRT A-018-DC(1), 14-34-0001-2109.

Descriptors: *Recreation benefits, *Recreational use, *Willingness-to-pay, *Contigency valuation method, Household production function, Option value, Willingness-to-sell, Unit-day-values, Travel cost method, Social aspects, Economic aspects, Pareto optimality, *Literature reviews, Criteria.

The objective of this study was to examine the issues related to the use of Willingness-to-Pay (WTP) based methods in evaluating recreational benefits. This research is a continuation of a research report 'An Evaluation of Recreational Benefits and Use Estimating Models for Water Resource Planning' available through NTIS (PB82-198003). A literature search was conducted and its results are reported. The major findings of the research include (1) the use of any WTP based method does not lead to Pareto optimal social arrangements, (2) WTP does not take into account that public resources are commonly owned, which means that each member of a society is an equal resource owner, (3) WTP is an income biased approach, (4) use of the WTP via the travel cost method assumes that a well defined individual (or household) recreation demand function exists, which is a herioc assumption, and (5) WTP is not compatible to the political process involved in recreation planning. The report concludes that the Unit-Day-Value method, although minimally treated in the literature, represents a robust alternative to recreation benefits evaluation, and it presents a framework for effective agency UDV implementation. Guidelines for additional research necessary for UDV derivation are provided.
W83-02323

ECONOMIC ASPECTS OF COST-SHARING ARRANGEMENTS FOR FEDERAL IRRIGATION PROJECTS: A CASE STUDY,
Colorado State Univ., Fort Collins. Dept. of Economics.
For primary bibliographic entry see Field 6C.
W83-02327

ECONOMIC ANALYSIS OF ALTERNATIVE DOMESTIC WATER SUPPLIES,
North Dakota State Univ., Fargo. Dept. of Agricultural Economics.
W. C. Nelson, and R. C. Coon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182113, Price codes: A03 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute, Fargo, Completion Report, July 1981. 35 p, 6 Fig, 8 Tab, 25 Ref. 1 Append. OWRT A-067-NDAK(1), 14-34-0001-0136.

Descriptors: *Water distribution, *Rural areas, *Domestic water, *Regional analysis, *Computer models, Simulation design, Groundwater, Water supply, Water delivery, *Alternative water supply, Linear programming, Montana, North Dakota, *Economic analysis, Great Plains.

The Great Plains Region has numerous domestic water supply problems due to insufficient and poor quality groundwater. This condition has led to rapid development of joint rural water systems. This project is Phase One of the development of a computerized model to design and evaluate alternative domestic water supply systems for rural areas. A linear programming model was modified to design a least cost water delivery network of underground pipe. It is operational and when combined with an elevation simulation model, designs a complete joint rural water system including the delivery network, pressure booster stations, reservoirs, pumps, and cost estimate for the entire system. The second part of the system, not currently operational, will analyze three additional means of supplying domestic water: (1) private individual wells; (2) hauling by truck; and (3) surface water collection and storage. Various treatment methods can be combined with any of the methods. The objective of the overall system is to be able to compare each of the four methods and combinations of the four methods on a regional basis. This may involve a joint rural water system servicing the higher population density areas and using truck deilvery and surface collection in low denisty areas of a region. Parts of the simulation model have been tested in a two-township region in North Dakota and a thirty-township region in Montana.
W83-02369

FACILITATION OF COMMUNITY ORGANIZATION,
Research Triangle Inst., Research Triangle Park, NC.
R. B. Isely, and C. R. Hafner.
Water Supply and Management, Vol 6, No 5, p 431-442, 1982. 3 Fig, 25 Ref.

Descriptors: *Developing countries, *Public participation, *Water management, Social aspects, *Community organization, Organizations, Water resources development, Management, Water supply, Sanitation, Maintenance, Public health, Benefits, Data collections, Rural areas, *Cameroon.

Water supply and sanitation programs in rural areas of developing countries do not succeed without community organization and involvement. A general description of a process for using and enhancing existing community organization for problem solving consists of 11 steps in the pathway toward stated objectives. Beginning with meeting leaders and information gathering, through defining problems and implementation of plans, the process ends with evaluation. The population must participate in an organized way in repair of water supply and sanitation facilities as well as in the proper use and protection of the water supply through the practice of proper personal and domestic hygiene. For successful community organization involvement four conditions are relevant: personnel trained in community diagnostic, supportive, and evaluative skills; information about the community; integrated approaches among sectors (public works, education, sanitation department, agricultural and home extension services, and health department); and technology and information suitable for the village's stage of development. Case histories from 2 villages in Africa illustrate three potential outcomes of facilitating community organization: reinforcement of local management capacities, enhancement of participation in the program, and increased probability of program success. (Cassar-FRC)
W83-02395

LEGAL AND ADMINISTRATIVE SYSTEMS FOR WATER ALLOCATION AND MANAGEMENT: OPTIONS FOR CHANGE. SEVEN PER-

SPECTIVES ON ASPECTS OF WATER RESOURCE PLANNING IN THE SOUTHEASTERN STATES,
Virginia Water Resources Research Center, Blacksburg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187120, Price codes: A19 in paper copy, A01 in microfiche. Completion Report, March 1983. 418 p, 6 Fig, 9 Tab, 11 Append. Walker, W. R., Cox, W. E., and Hrezo, M. S., eds. OWRT B-123-VA(1).

Descriptors: *Water law, Water resources planning, *Planning, Water resources management, *Water management, *Decision making, Water management policy, Water policy, *Water allocation, Conjunctive management, Instream flow protection, Interbasin transfer, *Interjurisdictional transfer, *Riparian doctrine, Water quality, Water quantity, Water supply, Drought, *Southeast U.S.

This report analyzes seven aspects of water resources planning and management and their implications for the southeastern United States. Its purpose is to provide an assessment of alternatives for changes in the water law of the Southeast. 'Allocation of Supplies Among Competing Offstream Users Within the Basin' (99 footnotes) suggests that permit systems offer improved capability for balancing public and private interests in water but that this option may be too severe for states with a general abundance of water resources. Options assessed in 'Accommodating Interwatershed Transfer Under the Riparian Doctrine' (26 footnotes) include a declaration that any water use is protected from actions for damages in the absence of material injury, establishment of reasonableness as the sole criterion for evaluating the legal standing of a nonriparian use, adoption of a procedure for protecting inbasin water users, establishment of a water use reporting system, and creation of an arbitration board. 'Protection of Instream Flows' (81 footnotes) presents measures already in effect in some states and federal actions designed to protect minimum flows. 'Integration of Land and Water Management' (118 footnotes) suggests alternatives including consolidation of land and water management programs into a single administrative structure, comprehensive planning, and coordinated permitting. Optional institutional measures discussed in 'Conjunctive Management of Surface and Ground Water' (43 notes) are a legislative declaration that conjunction management is state policy, use of economic incentives to encourage conjunctive management, and reliance on water regulatory systems to conjunctively manage water resources. 'Integration of Water Quality Control and Water Quantity Management' (22 notes) focuses on four institutional options: statewide permitting, the capacity use area approach, the prior appropriation approach, and an approach based on the registration of water uses combined with a drought management strategy. 'Water Allocation During Water Shortages' (207 footnotes) discusses encouragement of water conservation through economic incentives and education, initiation of statewide planning for water shortage management, and implementation of a comprehensive shortage management program within the framework of water use permitting.
W83-02404

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

FINANCING WATER RESOURCES: COST ALLOCATION, COST SHARING, INCENTIVES.
Georgia Univ., Athens. Inst. of Natural Resources.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178145, Price codes: A07 in paper copy, A01 in microfiche. Proceedings, A Technology Transfer Workshop, Sept. 20-23, 1977, Jekyll Island, Ga. North, R. M., and Hanke, S. H., ed., June 1982. 116 p, 5 Fig, 6 Tab, 19 Ref. OWRT T-0016(6710)(1), 14-34-0001-6710.

Descriptors: *Financing, *Cost sharing, Revenue sharing, *Benefit sharing, *Cost allocation, *Pricing, Funding, Water projects.

These proceedings focus attention on the developing issues, problems and opportunities associated with financing and paying for the investments and costs of water resources project and programs. Selected participants prepared 17 papers on the problems of financing and cost sharing in water resources planning, implementation and operations. The 1976 Water Resources Council study on 'Planning and Cost Sharing Policy Options for Water and Related Land Programs' (P.L. 93-251, Sec. 80(c)) served as a focus for policy issues and researchable problems. The position papers and four workshop summaries included the following areas: (1) A history of Federal, non-federal cost sharing and financing arrangements, (2) the development of rationale (or theories) for cost sharing, (3) reports on the existing nominal and effective cost sharing rates for planning, construction and operations of surveys, projects and programs, (4) the development of alternative cost and sharing options.
W83-02234

COST INDEX TRENDS AND COMPARISONS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
B. M. Berthouex, and Y. Pathak.
Journal of the Water Pollution Control Federation, Vol 54, No 9, p 1331-1332, September, 1982. 1 Fig, 1 Tab.

Descriptors: *Costs, *Construction costs, Water pollution control, *Wastewater treatment plants, Buildings, Construction equipment.

Five cost indexes for pollution control projects increased by an average of 9-10% per year from 1971 to 1979, compared with about 3% from 1950 to 1970. These indexes were: U.S. EPA (small city conventional treatment, large city advanced treatment, and complete urban sewer systems), Marshall and Stevens equipment index, Chemical and Engineering index, and Engineering News-Record (separate indexes for construction and building). (Cassar-FRC)
W83-02285

ECONOMIC ASPECTS OF COST-SHARING ARRANGEMENTS FOR FEDERAL IRRIGATION PROJECTS: A CASE STUDY,
Colorado State Univ., Fort Collins. Dept. of Economics.
K. Ghebreyohannes, R. A. Young, and E. W. Sparling.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182014, Price codes: A04 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Fort Collins, Completion Report No 118, December 1982. 63 p, 3 Fig, 6 Tab, 23 Ref, 5 Append. OWRT A-015-COLO(2), 14-3-0001-3860, 4006, and 5006.

Descriptors: *Irrigation, *Economics, *Cost-sharing, *Water policy, *Costs, *Cost allocation, Federal project policy, *Colorado, Narrows project, Case studies.

The philosophy of the Reclamation Act of 1902 was that all reclamation project costs should be repaid in full except interest on construction costs. However, early reclamation cost-sharing policy was not successful in that repayments to the government fell short of planned levels. This led to a series of changes culminating with the Reclamation Act of 1939. It revised reclamation policy from total repayment of cost to repayment on an 'ability to pay' basis determined by USBR. Since that time charges for USBR-supplied irrigation water have not been required to reflect the cost of water supply. Consequently, there has been a growing concern with the degree to which reclamation irrigation projects are subsidized. Critics believe that it is unlikely that water users would agree to contract for reclamation projects if they were to bear full cost. The proposed Narrows Unit on the South Platte River in N.E. Colorado has been taken as a case study. A modeling approach is employed to measure ability to pay as compared with full cost and the USBR current charging procedures. Estimate of average benefit (1976 price levels) accruing with the advent of the Narrows Project is $44 per acre-foot in the case for which water is delivered to formerly non-irrigated lands. If the water were to supplement supplies on lands formerly inadequately irrigated, the estimated benefit is $32 per acre-foot. If lands had been adequately irrigated with groundwater, the net benefit would be about $8 per acre-foot (equivalent to the cost savings from replacing wells and pumps). Repayment capacity of the irrigation beneficiaries was computed on ability-to-pay criterion by USBR at $14.56 per acre-foot. However, the expected cost of irrigation water is estimated to be $63.49 per acre-foot of water received at farmers' headgates (also 1976 prices) if water users were to repay all costs allocated to irrigation purposes, including interest at 6-1/2%. Results show water price charged under ability-to-pay criterion reflects only a fraction of true cost. Water users could not profitably contract for USBR-supplied water if they were to bear full irrigation project costs.
W83-02327

OPERATION AND MAINTENANCE IN SURFACE IRRIGATION PROJECTS IN INDIA,
Asian Development Bank, Manila (Philippines). Irrigation Div.-1.
T. K. Jayaraman.
Water Supply and Management, Vol 6, No 5, p 405-415, 1982. 2 Fig, 4 Tab, 5 Ref.

Descriptors: *Operating costs, *Maintenance costs, *Irrigation programs, Planning, Gujarat State, *India, Surface irrigation, Budgeting, Costs, Economic aspects, Expenditures.

A study of operations and maintenance (O and M) expenditures for irrigation projects in India indicates that a large proportion of the limited funds for this purpose is used for salaries of temporary staff hired for seasonal repairs. Although governments and international funding agencies supply money for capital projects, allocation of money for O and M is usually neglected. O and M expenses were not separated into canal and head works or work-changed and regular establishment in most of the state budgets. Using Gujarat State as an example, O and M expenses were less than revenue earned from the projects for 7 of 11 years. Actual expenditures for this state were greater than the national average. Appropriate O and M expenditures for a given region may be calculated from a model, which depends on the gross irrigated area, O and M expenditures per ha of the potential area created, agricultural price index, year, and an error term. Several changes in policy are recommended: (1) provide more funds for physical repairs, keeping the salary component to a minimum, and (2) revise the accounting procedures so that O and M expenses are broken into appropriate categories, providing more statistics for planning and evaluation. (Cassar-FRC)
W83-02381

6D. Water Demand

COMMENT ON 'A REEVALUATION OF PRICE ELASTICITIES FOR IRRIGATION WATER' BY RICHARD E. HOWITT, WILLIAM D. WATSON, AND RICHARD M. ADAMS; AND REPLY BY AUTHORS,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
W. E. Martin, R. A. Selley, and D. C. Cory.
Water Resources Research, Vol 18, No 4, p 1302-1308, August, 1982. 5 Fig, 8 Ref.

Descriptors: *Irrigation, *Pricing, *Estimating, Mathematical studies, Linear programming, Quadratic programming, Computers, *Water demand.

In this comment on the cited research (Water Resources Research, Vol 16, No 4, p 623-628, 1980) the current authors take exception to the interpretation given to a crucial equation presented. The original research tried to demonstrate that the use of quadratic programming rather than linear programming in estimating the derived demand for irrigation water will yield more elastic

estimates of demand. The empirical example as used purports to demonstrate these results, which are claimed on the basis of a mathematical proof to be conceptually correct. During the examination of the mathematical proof the current authors found what they describe as an error in the interpretation given to a specific equation. In the reply by the original authors an attempt is made to discuss the pertinence of the theoretical results developed in both papers, to demonstrate that in the multioutput case considered the original conclusion has a strong intuitive basis and is in agreement with the main theoretical conclusion reached by the reviewer, and to show that the empirical result is credible and represents the actual marginal revenue product schedule for water. (Baker-FRC)
W83-02164

SPATIAL UTILIZATION OF VERMONT LAKES BY RECREATIONAL BOATERS,
Vermont Univ., Burlington. School of Natural Resources.
For primary bibliographic entry see Field 6E.
W83-02183

THE WATER REQUIREMENTS AND POLLUTANT POTENTIAL IN THE GASIFICATION OF CARBONACEOUS SHALES,
Utah Water Research Lab., Logan.
J. A. Cissell, V. D. Adams, J. E. Fletcher, D. S. Filip, and D. B. George.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177964, Price codes: A04 in paper copy, A01 in microfiche. Utah Water Research Laboratory Water Quality Series UWRL/Q-82/04, October 1982. 59 p, 12 Fig, 14 Tab, 50 Ref. OWRT A-043-UT(1), 14-34-0001-9047.

Descriptors: Carcinogens, Cooling water, *Coal gasification, *Lignite, *Utah, *Process water, *Shales, Water pollution sources, *Water requirements, *Synthesis gas, Carbonaceous shales, Industrial water.

The Upper Colorado River Basin has vast deposits of lignaceous shales which now go largely unused but could potentially provide a valuable product through gasification. The technical feasibility of applying gasification processes currently used for coal, the water requirements of gasification in an arid climate, and potential pollution problems were examined through a series of laboratory studies. The results indicate that a synthesis gas, consisting primarily of hydrogen and carbon monoxide, can be produced from carbonaceous shales. Heating values ranged from 4 to 62% of that of gas obtained from coal with the percentage largely determined by the amount of intermixed organic material. Optional process water use was estimated. The shales require additional cooling water for ash quenching. Process and cooling water requirements both ran 5 to 15% higher than those for coal. Quantities of phenols, ammonia-N, and total organic carbon produced were significantly less for the shales tested than for the coal. Differences in process condensate constituents, such as mutagenicity and trace elements, were also determined for the coal and shale samples. Results varied widely with the chemical characterization of the coal and shale.
W83-02211

THE ROLE OF WATER RESOURCES IN THE LOCATION OF SOUTH CAROLINA INDUSTRY,
Clemson Univ., SC. Dept. of Agricultural Economics and Rural Sociology.
B. L. Dillman, J. S. Lytle, W. E. Twilley, Jr., and P. C. Luisa.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181982, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report No 98, December 1982. 54 p, 2 Fig, 5 Tab, 57 Ref, 1 Append. OWRT A-039-SC(1), 14-34-0001-6042.

Descriptors: *Industrial development, Industrial water, Entropy, *Regional analysis, Regression analysis, *Industrial location, Gravity models, Potential models, Manufacturing, *South Carolina, Water pollution control.

Population potential, a distance-weighted measure of human resource and market potential mass, was used in a prediction model for plant locations and as a criterion for separating existing plants into categories for testing hypotheses about water related manufacturing industries in South Carolina. It was found that concentration, as measured by an entropy model, has occurred since 1970 for heavy water users and other manufacturing plants, but that the concentration is much more dramatic for the heavy water users. This concentration was more noticeable as population potential increased, except for the highest population potential class where concentration was presumably intense already. The occurrence of federal water pollution legislation and increases in stream standards, around 1970, has altered the relative desirability of locating on flowing streams. There now is a tendency for new plants to locate near urban areas and near other plants to take advantage of the many benefits of more concentrated factor markets and urban amenities afforded by more densely populated areas and(or) to have access to urban water and waste treatment systems.
W83-02324

DEVELOPMENT AND OPERATIONAL STRATEGIES FOR WATER RESOURCE AND SUPPLY SYSTEMS,
For primary bibliographic entry see Field 6A.
W83-02387

CHANGES AND PROCESSES OF WATER RESOURCE DEVELOPMENT AND FLOOD CONTROL IN POST-SECOND WORLD WAR JAPAN,
Tokyo Univ. (Japan). Dept. of Civil Engineering.
Y. Takahasi.
Water Supply and Management, Vol 6, No 5, p 375-386, 1982. 5 Fig, 10 Tab.

Descriptors: Environmental effects, *Water demand, Water resources developement, Eutrophication, Levees, Water pollution effects, Multipurpose reservoirs, *Japan, Dam effects, Social impact, Water use, Recreation, *Flood control, Urbanization, Industrial development, Municipal water.

Water demand in Japan has increased dramatically since the end of the World War II. Development of water resources to meet the increased household and industrial consumption and to control floods has resulted in significant environmental changes. Projects included construction of multipurpose reservoirs, saline water barriers in river mouths, river levee systems, flood control dams, and river works. At present 2060 dams exist, compared with 781 in 1930. Urbanization and industrialization have also had a great impact on flooding and water quality. Some of the negative impacts are: larger floods with increased peak discharges and flood wave velocities, more urban property vulnerable to flood damage, increased sedimentation rate in reservoirs, scouring of river beds near bridges and weirs, coastal erosion, river water quality deterioration (eutrophication and increased turbidity), damage to fisheries, changes is scenery, impairment of recreation, disappearance of brooks, and displacement of people by filling reservoirs. (Cassar-FRC)
W83-02393

6E. Water Law and Institutions

ON THE MUTUALLY BENEFICIAL COOPERATIVE SCHEME: DYNAMIC CHANGE IN THE PAYOFF MATRIX OF INTERNATIONAL RIVER BASIN SCHEMES,
Waterloo Univ. (Ontario). Dept. of Geography.
C. M. Dufuornaud.
Water Resources Research, Vol 18, No 4, p 764-772, August, 1982. 6 Fig, 5 Tab, 22 Ref.

Descriptors: *Water management, *International agreements, Resources management, Water supply, Water resources development, River basins, Economic aspects, Riparian rights, Water rights, Columbia River Basin, Lower Mekong River Basin.

Mutual benefit is the most common criterion by which scholars view international cooperative river basin schemes. Possibilities open to riparian parties in the Columbia and Lower Mekong River Basin schemes are explored by demonstrating the various dynamic paths of the net benefits of such cooperative and sovereign schemes. The analysis as given suggests a substantial preoccupation on the part of the riparians with the economic gains from cooperation, providing that these are certain. In the Columbia there is good reason to suggest that the negotiations demonstrated a willingness on the part of Canada to settle for less than it could have obtained. In the Mekong the gains from joint development required cooperation of a long-term nature, an event not realistic in the political climate of the time. From a managment perspective it is noteworthy that nations negotiate positions they desire on the basis of the criterion of mutual benefit, providing that it holds under the circmstances that they perceive to be important. (Baker-FRC)
W83-02160

SPATIAL UTILIZATION OF VERMONT LAKES BY RECREATIONAL BOATERS,
Vermont Univ., Burlington. School of Natural Resources.
A. H. Gilbert, J. J. Lindsay, R. E. Manning, and M. B. Lapping.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175281, Price codes: A09 in paper copy, A01 in microfiche. Vermont Water Resources Research Center Completion Report, Univ. of Vermont, Burlington, December 1982. 92 p, 4 Fig, 23 Tab, 30 Ref, 3 Append. OWRT A-043-VT(1).

Descriptors: Lakes, *Recreation, *Boating, Aerial photography, *Lake management, *Vermont, Lake Champlain, Waterbury Reservoir, Public access areas, *Recreation demand, Surveys, *Recreation facilities, Holding tank facilities, Sanitory facilities.

Research was initiated in the summer of 1980 to assess the status of boating activity on Vermont lakes. Objectives of the study were to determine the nature and extent of boating-related problems and to develop recommendations for their resolution. The geographic focus of the study was Lake Champlain and Waterbury Reservoir. Study methods included aerial photography of boating activity, surveys of lake boaters, shoreline owners and marina operators, and a literature review of water-based recreation laws, regulations and management alternatives. Major boating-related problems and issues were found to be lack of adequate access and berthing capacity, insufficient holding tank pump-out facilities, conflicts between boaters and shoreline residents, and the special importance of 'near-shore' waters for boating activity. Major recommendations include development of a more active information/education program for boaters, state registration of non-power boats, additional reliance on provisions of the Shoreland Zoning Act and Mooring Management Act to ensure a more coordinated approach to lake management, state requirements for pump-out facilities at marinas which service boats with on-board sanitary facilities, and development of several different types of public access areas.
W83-02183

STATUTORY RECOGNITION OF INSTREAM FLOW PRESERVATION: A PROPOSED SOLUTION FOR WYOMING,
R. A. Thompson.
Land and Water Law Review, Vol 17, No 1, p 139-154, 1982. 65 Ref.

Descriptors: *Water law, *Instream flow, *Appropriation, Legal aspects, *State jurisdiction, *Wyoming.

Although Wyoming has not yet joined other western states in recognizing the value of dedicating water to in-stream uses through the enactment of

statutes providing for instream flows for fish, wildlife, and recreational purposes, there is increasing concern regarding this issue in the state. The Wyoming legislature has considered several bills addressing instream flow, but none have passed. A review of the problems of preserving instream flows under the existing appropriation doctrine demonstrates that the major doctrinal barriers are the requirement for an actual diversion of water and for application of the water to a beneficial use. None of the methods available for protecting instream flows under existing Wyoming law are wholly satisfactory. It is suggested that instream flow legislation designed to protect instream uses in Wyoming without harming existing water users include designation of instream flows for fish and wildlife preservation as a beneficial use; elimination of the actual diversion requirement; granting of instream flow appropriations only to public, as opposed to private, entities; specification that the instream flow appropriation does not carry with it the power of condemnation; creation of an Instream Flow Commission charged with handling administrative responsibilities; and provision for public hearings with respect to the determination of the minimum stream flows to be appropriated. (Carroll-FRC)
W83-02190

CASE NOTES,
J. F. Araas.
Land and Water Law Review, Vol 17, No 1, p 155-168, 1982. 84 Ref.

Descriptors: *Legal aspects, *Judicial decisions, *Water rights, Appropriation, *Indian reservations, *Indian water rights, Colville Indian Reservation, *Washington.

In 1981, the Ninth Circuit Court of Appeals reversed the decision of the district court which held that an individual Indian Tribal member allotted a portion of the tribal land could not transfer the 'full' amount of his reserved water rights to a non-Indian purchaser. The appellate court found that the Indian allottee could transfer his implied reserved water rights to the non-Indian purchaser and that the purchaser acquires the Indian allottee's priority date both with respect to the amount of water appropriated by the Indian at the time of the conveyance and with respect to the amount of water that the non-Indian purchaser appropriates with reasonable diligence after passage of the title to the land. The case, Colville Confederated Tribes v. Walton, has been appealed to the Supreme Court. The Colvilles contend that the Tribe's reserved water rights are superior to the non-Indian purchaser's rights and that there is an insufficient amount of water to satisfy both parties' needs. The ruling by the Court of Appeals appears to contravene the principles established in Winters v. the United States (1908) and subsequent Supreme Court cases. Established law dictates that the transferability of the Indian allottee's reserved water rights be limited to situations that would continue to fulfill the purposes of the Colville reservation. In addition, a balancing of equities would show that, while the Indian allottee and the non-Indian purchaser would benefit, both the tribe and other non-Indian appropriators would be adversely affected by transfer of the 'full' amount of the Indian allottee's reserved water rights. Substantial consideration should be accorded to the interests of the tribe, since the water was impliedly reserved to fulfill the purposes of the reservation. (Carroll-FRC)
W83-02191

NO FEDERAL COMMON LAW OF NUISANCE FOR WATER POLLUTION,
N. R. Long.
Natural Resources Journal, Vol 22, No 2, p 441-454, April, 1982. 99 Ref.

Descriptors: *Water pollution control, *Legislation, *Federal jurisdiction, Wastewater effluent, Wastewater disposal, Water pollution sources, Milwaukee, Illinois, Federal common law.

In a dispute between the State of Illinois and the City of Milwaukee, the Supreme Court, in 1972, proclaimed a 'federal common law of nuisance' action for alleged discharges of inadequately treated or untreated sewage into Lake Michigan. The State of Illinois had claimed that overflow discharges from Milwaukee, Wisconsin sewage systems along with inadequately treated sewage from the two treatment plants in Milwaukee had become a health threat to Illinois' citizens. Illinois also stressed that the sewage was accelerating the eutrophication of Lake Michigan. Shortly after the 1972 decision, Illinois sued Milwaukee under federal common law to abate the alleged public nuisance. Federal Water Pollution Control Act Amendments of 1972 and 1977 both caused significant changes in the situation. Milwaukee obtained permits for its sewage discharges, but was unable to comply with the permit requirements. In 1977 the state court issued a judgment and set a timetable within which Milwaukee had to comply with its permits. Illinois proceeded in its action, and the suit eventually culminated in a ruling based on the federal common law of nuisance. The district court rejected Milwaukee's claim that the FWPCA preempted the federal common law and ordered the City to cease discharging raw sewage into Lake Michigan. The Supreme Court reversed the lower federal courts and overruled the 1972 decision. As a result, federal common law remedies for environmental torts will not be available if Congress has legislated a comprehensive regulatory scheme for a particular subject area. (Baker-FRC)
W83-02200

MINERAL DEVELOPMENT AND THE COASTAL AREAS,
Alabama Univ., University. School of Law.
H. Cohen.
Journal of Energy Law and Policy, Vol 3, No 1, 1982. p 113-168, 144 Ref. OWRT B-080-ALA(2).

Descriptors: *Coasts, *Resources development, *Estuaries, *Legal aspects, *Oil industry, *Alabama, Legislation, Jurisdiction, Institutional constraints, Wetlands, Environmental effects, Saline water intrusion, Water quality.

Alabama is used as a specific example of the impact that mineral development, especially oil and gas drilling and production, may have on our coastal and estuarine zones, and the methods being used to deal with the problem. Oil and gas development affects the coastal environment through such activities as maintenance dredging, pipeline operations, drilling operations, and the installation of permanent structures. A primary concern associated with oil and gas operations in the coastal zone of Alabama is the potential damage to fresh water resources; dredging, canal construction, fresh water withdrawals from aquifers, and underground disposal of salt water produced concurrently with oil and gas may permit the invasion of salt water and pollution of fresh water. The Alabama legislature first passed its Coastal Area Act in 1973; that act was repealed and a new act was passed in 1976. In both statutes a Coastal Area Board was created, and the Board given very broad powers. It acts as a restraining element along the coast and tries to maintain the status quo in water and land use quality. Perhaps the most basic source of control over the coastal areas is found in the Army Corps of Engineers' jurisdiction. The large number of agencies concerned with the coastal area in many states tends to blunt the possibility of direct and comprehensive regulation of the coastal zone. Further, federal and state authorities divide the jurisdiction in such a manner that there will be continuing litigation. The clash between public control and private ownership of coastal areas and wetlands may never admit of a completely satisfactory solution. (Moore-SRC)
W83-02226

ALTERNATIVE STRUCTURES FOR WATER RIGHTS MARKETS: OVERVIEW AND HYPOTHETICAL CASE STUDY,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
J. W. Eheart, R. M. Lyon, and B. D. C. Wong.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178095, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Center Publication No 174, Univ. of Illinois, Urbana-Champaign, January 1983. 76 p, 11 Fig, 2 Tab, 29 Ref, 4 Append. OWRT A-109-ILL(1), 14-34-0001-2115.

Descriptors: *Water rights, *Markets, *Water permits, Economics, Riparian rights, *Alternative water use, Cost effectiveness, *Cost repayment.

Although there has been general interest in the use of systems of transferable water rights to increase efficiency and flexibility of present water allocation systems, there has been relatively little research into the specific details of these market systems. The design of systems of marketable permits for water consumption from natural water courses was examined through a qualitative overview and a quantitative quasi-empirical, quasi-hypothetical case study. The most important considerations of the study were associated with the uncertainty of future streamflows and economic conditions, locational issues, and efficient and effective functioning of the markets. Particular attention was given to the problem of implementing marketable rights systems in regions presently following the riparian doctrine. In these regions the most important design decisions include the basis of definition of permits, the means for initially distributing them, the type of market mechanism used for their transfer, and the restrictions placed on their use and transfer. Two market systems were assessed and compared with two alternative nonmarket systems and to an optimal scheme. The market systems recoup about 95% of the optimal distribution.
W83-02229

LEGAL AND ADMINISTRATIVE SYSTEMS FOR WATER ALLOCATION AND MANAGEMENT: OPTIONS FOR CHANGE. SEVEN PERSPECTIVES ON ASPECTS OF WATER RESOURCE PLANNING IN THE SOUTHEASTERN STATES,
Virginia Water Resources Research Center, Blacksburg.
For primary bibliographic entry see Field 6B.
W83-02404

6F. Nonstructural Alternatives

VALUATION AND ACQUISITION OF FLOODPLAIN LANDS FOR STREAM VALLEY PARKS,
Georgia Univ., Athens. Coll. of Business Administration.
C. F. Floyd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173310, Price codes: A05 in paper copy, A01 in microfiche. Georgia Institute of Technology, Environmental Resources Center Report Number ERC 01-82, Atlanta, June 1982. 75 p, 4 Maps, 5 Plats, 30 Ref. OWRT B-127-GA(1), 14-34-0001-7100.

Descriptors: *Acquisition, *Appraisals, Dedication, *Flood plains, *Flood plain zoning, *Land use, Land use controls, Mandatory dedication, Valuation, *Georgia, Athens, Sandy Creek Greenway, *Parks.

As more and more communities have become aware of the economic and environmental benefits arising from the protection of floodplains, interest has risen in the concept of stream valley parks. Acquisition of land for these parks can take several forms, including purchase and gifts, fee simple acquisition or easements. No matter what the method of acquisition, an appraisal of the real estate interests being acquired will almost always be required. The appraisal of floodplain lands for recreational purposes raises many questions and problems for appraisers. Among these are (1) basic conflicts between public and private benefits in the appraisal concept of highest and best use; (2) a lack of comparable sales for floodplain land and difficulties in adjusting to adequately reflect the value of floodplain lands; (3) the necessity to consider the impact of floodplain, mandatory dedication of parkland, and other land use controls, and; (4) the absence of data concerning the impact on value of

remaining lands from the acquisition of trail easements.
W83-02140

REDUCING FLOOD INSURANCE CLAIMS THROUGH FLOOD WARNING AND PREPAREDNESS,
Flood Loss Reduction Associates, Palo Alto, CA.
H. J. Owen, M. Wendell, J. Jorgenson, and M. Hughes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181784, Price codes: A05 in paper copy A01 in microfiche. Report, April 1983. 83 p, 8 Fig, 11 Tab, 37 Ref, 2 Append. OWRT C-00005-G(No 1433)(1), 14-340001-1433.

Descriptors: *Flood plan insurance, *Flood forecasting, *Warning systems, *Insurance, Flood damage, *Flood protection, *Non-structural alternatives, Economics, Flood plains, River forecasting.

A preliminary evaluation was made of the engineering, legal, economic and institutional aspects of offering a differential in flood insurance rates for communities having flood warning and preparedness programs. Investigation focussed on: 1) whether administratively operable minimum criteria could be developed for judging the potential effectiveness of local flood warning and preparedness programs; 2) the extent of incentive to implement and operate a flood warning and preparedness program that would be provided to communities by various rate differentials; 3) the broad national costs and benefits of stimulating the implementation and operation of local flood warning and preparedness programs; 4) the appropirate roles and relationships of the National Weather Service, the Federal Emergency Management Agency and other agencies with missions related to implementation and operation of the concept; and 5) the nature of the modifications to existing statutes that would be necessary to implement the concept. The report concludes that the concept of offering a rate differential to encourage development of local flood warning and preparedness programs has sufficient merit to warrant detailed investigation.
W83-02319

ECONOMIC POTENTIALS FOR MANAGING NUTRIENT LOSS WITH ALTERNATIVE IRRIGATION TECHNOLOGIES,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
H. J. Vaux, Jr., and B. K. Stevens.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187112, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, Univ. of California, Davis, March 1983. 26 p, 19 Ref. OWRT-B-029-CAL(1).

Descriptors: *Input-output analysis, Economic aspects, Nonpoint pollution sources, *Nitrates, Alternative planning, *Taxes, *California, San Joaquin Valley, *Nutrient loss, *Pollution taxes, Residual charges, *Effluent changes.

The objective was to examine the economic properties of input taxes and alternative production technologies as instruments for controlling nonpoint source pollutants. A theoretical analysis demonstrates that input taxes have the economic properties of residuals charges. The use of alternative production technologies is not a promising method of controlling effluents when compared with pollution taxes. Even though inputs may be used more efficiently with new production technologies, controlling technology does not control the quantity of inputs used. The empirical research on nitrate-nitrogen controls in the southern San Joaquin Valley confirms the interchangeable nature of input large and residuals charges. Some evidence supporting the second hypothesis was also found since the social costs of requiring sprinkler irrigation were nearly twice the social cost of an equivalent pollution penalty. Furthermore, the results indicated that nitrate losses from cropping activities in some parts of the Central Valley may not be very large. (Snyder-California)
W83-02403

6G. Ecologic Impact Of Water Development

A FAUNAL AND SEASONAL STUDY OF THE AQUATIC INSECTS IN TWO WATER ECOSYSTEMS IN SOUTH ARKANSAS - DEGRAY RESERVOIR AND THE UPPER CADDO RIVER,
Arkansas Water Resources Research Center, Fayetteville.
R. T. Allen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173187, Price codes: A03 in paper copy, A01 in microfiche. Publication No 88, October 1982. 22 p, 18 Tab. OWRT A-046-ARK(1), 14-34-0001-8004.

Descriptors: Aquatic animals, *Aquatic insects, *Ecosystems, *Aquatic habitats, Impoundments, Biota, Seasonal, Reservoirs, Data collections, Systematics, Taxonomy, DeGray Reservoir, Upper Caddo River, *Arkansas.

The impounding of the lower Caddo River to create DeGray Reservoir radically changed the water habitats in that portion of the Caddo River. A number of new and different habitats were created by the lake. The objective of this study was to determine what, if any, differences existed between the aquatic insect biotas of DeGray Reservoir and the upper Caddo River. Four collecting stations along the shore of DeGray Reservoir and four stations along the upper Caddo River were selected as sampling sites. Collections were made at one month (March, April, October, November) intervals, or at two week intervals (May, June, July, August, September) from March to December, 1979. The data collected indicate that the upper Caddo River is approximately three times as rich in the diversity of taxa collected and the number of individuals collected as DeGray Reservoir.
W83-02127

INTERACTIVE MODELING AND DATA MANAGEMENT FOR PREDICTING SURFACE AND GROUNDWATER QUALITY AND QUANTITY,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
For primary bibliographic entry see Field 6A.
W83-02130

ECOLOGY AND PATHOLOGY OF WILDLIFE IN RESPONSE TO SPRAY IRRIGATION OF CHLORINATED SEWAGE EFFLUENT-PHASE II,
Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 3C.
W83-02135

COMMENT ON 'STREAM SYSTEM EVALUATION WITH EMPHASIS ON SPAWNING HABITAT FOR SALMONIDS' BY MOSTAFA A. SHIRAZI AND WAYNE K. SEIM; AND REPLY BY AUTHORS,
Oregon State Univ., Corvallis. Dept. of Forest Engineering.
R. L. Beschta.
Water Resources Research, Vol 18, No 4, p 1292-1298, August, 1982. 3 Fig, 1 Tab, 28 Ref.

Descriptors: *Spawning, *Sedimentation, *Fisheries, Land use, Water pollution effects, Silt, Sediment concentration, Gravel, Habitats, Aquatic habitats, Environment.

In this comment on the cited research results (Water Resources Research, Vol 17, p 592-594, 1981) the current authors take some exceptions to the findings of the earlier investigators, with particular concern being shown in the area of an index of gravel composition. The present authors suggest that other than in rare instances the textural composition of spawning gravels in natural streams cannot be accurately represented by a lognormal distribution, and thus the d-g statistic can only be used as an indicator. Although the d-g index of spawning gravel quality appears strongly correlated with percent survival of fish embryos, it is apparently an insentive indicator of instream changes in gravel composition as a result of land use activities. Thus its usefulness for monitoring changes in the quality of spawning gravel in streams affected by management activities is questionable. Estimates of both the central tendency and the variance of sediment particle sizes in a spawning gravel sample are needed to obtain a more complete description of total sediment composition than can be provided by d-g or percent fines alone. The fredle index appears to combine both types of information. (Baker-FRC)
W83-02163

ENVIRONMENTAL FEATURES FOR FLOOD CONTROL CHANNELS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
F. D. Shields, Jr.
Water Resources Bulletin, Vol 18, No 5, p 779-784, October, 1982. 21 Ref.

Descriptors: *Environmental effects, *Channel improvement, *Flood control, *Reviews, Channel morphology, Stream improvement, Flood channel, Open channels, Low Flow, Excavation, Floodways, Vegetation, Water control, Oxbow lakes, Meanders, Aquatic habitats, Aquatic life, Habitats, Literature review.

A review of available information on the environmental effects of flood control channel modifications reveals that some recent projects have features designed to avoid or minimize adverse affects. Those projects which have successfully preserved or enhanced environmental values used a multidisciplinary approach from the beginning of the planning process. Some typical methods, techniques, and features used to enhance environmental quality in flood control channels are selective clearing and snagging, nonuniform channel geometries, aquatic habitat restoration and improvement, special treatments for excavated material, and revegetation. In selective clearing only the trees and obstructions causing significant problems are removed. Heavy equipment is used sparingly to minimize damage to banks, stream beds and vegetation. Nonuniform channel geometrics avoid the environmental impacts of straight trapezoidal channels. These include modifications on one bank only, often alternating banks to preserve trees to take advantage of hydraulic factors. Floodways can be constructed so that the existing stream serves as a low flow channel within an excavated high flow channel. (Cassar-FRC)
W83-02166

PUBLIC ATTITUDINAL FACTORS IN RIVER DEVELOPMENT AND CONSERVATION IN THE UPPER MISSISSIPPI RIVER REGION,
Missouri Univ.-Columbia. Dept. of History.
S. L. Flader, and P. V. Scarpino.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177923, Price codes: A11 in paper copy, A01 in microfiche. Missouri Water Resources Center, Columbia, Completion Report, December, 1982. 246 p, 216 Ref. OWRT B-138-MO(1), 14-34-0001-0269.

Descriptors: *Attitudes, *Conservation, *Environmental change, *History, *River development, Hydroelectric power, Locks and dams, Mussels, Navigational improvements, Nine-foot channel, Pearl button industry, Pollution, Resource policy, Water power, Wetlands drainage,*Mississippi River, *Minneapolis/St. Paul, *Keokuk Dam, *Lake Cooper, Winneshiek Bottoms, St. Louis.

The report analyzes the dynamic relationship between public and interest group attitudes, river development policies, and environmental change in the upper Mississippi River basin, principally in the period 1890-1945. Focussing on such developments as the Keokuk, Iowa, hydroelectric project, mussel propagation for the pearl button industry, wetlands drainage, establishment of the Upper Mississippi River Wildlife and Fish Refuge, the nine-foot

channel with its series of locks, dams, and pools, and the problems of pollution and pollution control (especially in Minneapolis/St. Paul and St. Louis), the study considers the social, economic, and attitudinal milieu of new developments and the responses of various interest groups to resulting changes in the river environment. By clarifying the long-term relationship between changing attitudes, river development, and conservation, the study provides perspective on the human factor in river management and planning.
W83-02207

MINERAL DEVELOPMENT AND THE COASTAL AREAS,
Alabama Univ., University. School of Law.
For primary bibliographic entry see Field 6E.
W83-02226

THE USE OF INVERTEBRATE INDICATORS FOR ECOLOGICAL RESILIENCY EVALUATION OF A FLOW REGULATED RIVER,
Idaho Univ., Moscow. Dept. of Civil Engineering.
D. F. Haber, and M. A. Brusven.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178087, Price codes: A05 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute Completion Report, Univ. of Idaho, Moscow, December 1982. 84 p, 36 Fig, 5 Tab, 15 Ref. OWRT B-049-IDA(1), 14-34-0001-9111.

Descriptors: *Regulated flow, *Benthic insects, *Benthic colonization rates, Indicators, Flow, Velocity, Substrate, Water temperature, *Species richness, Density, Rating curves, Hydro-peaking management, Resiliency, *Idaho, Clearwater River, *Bioindicators, Carrying capacity.

A systems approach was used to determine certain biological and physical indicators which were used to characterize the benthic ecosystem in the Clearwater River below Dworshak Dam, Idaho. Using these indicators, a Hectare-Day Index was developed that resulted in a quantitative measure of impact of regulated flow on the benthic system. For three selected periods, Summer 1978, Fall 1978 and Spring 1981 the reduction in the Hectare-Days Index when compared to an idealized constant flow for the same period was: 3.1% for the spring period, 5.5% for the summer and 5.5% for the fall period. The analysis of field tests over the period 1977 through 1980 indicated mean insect density and species richness decreased as depth increased from < 60 to > 300 cm; the density and richness increased from velocities of < 6 cm/sec to > 60 cm/s; in the Clearwater River where cobbles, boulders and sand represented over 95% of the dominant particle sizes among the various habitats. The rate of insect colonization on a sterile substrate was used to predict carrying capacity for main stem Clearwater River. Sixty days was predicted time required to attain full carrying capacity in the regulated reach. By point of contrast 47 days were required for the unregulated reach (Middle Fork).
W83-02228

LAKE ECOSYTEM RESPONSE TO FISH MANAGEMENT--A STEADY-STATE MODELING INVESTIGATION,
Maine Univ. at Orono. Land and Water Resources Center.
M. L. Hutchins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178103, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, December 1982. 24 p, 4 Fig, 1 Tab, 24 Ref, Append. OWRT A-056-ME(1), 14-34-0001-2121.

Descriptors: *Algal control, Aquatic populations, *Ecological effects, *Fish management, Mathematical models, Water quality management, *Lake ecosystems, Model studies, *Input-output analysis.

An input/output steady-state model descriptive of a simple five-component lake ecosystem was used to investigate possible long-term ecosystem response to selected fish management practices. In particular, the response of game fish and algal standing crops to various fish manipulations is explored. Results indicate that it may be physiologically possible for simple lake ecosystems to exist in either of two distinctly different states of equilibrium--a predator-dominated system in which algal standing crop is controlled primarily by predation, or a nutrient-limited system in which algal standing crop is controlled primarily by phosphorus inflow. In a predator-dominated system, any fish manipulation which in the long term increases game fish standing crop will also increase algal standing crop. In a nutrient-limited system, any forage fish perturbation which increases game fish standing crop will also increase algal standing crop, but game fish perturbations which benefit game fish should decrease algae. In general, harvesting game fish stimulates game fish production, while stocking game fish suppresses production. Stocking game fish appears justified only in situations of overharvest, and then only in amounts which exactly cover the excess harvest.
W83-02230

COMPARISON OF CENTRAL ASIAN CANALS AND THE SOUTHERN PART OF THE DIVERSION ROUTE OF SIBERIAN WATERS,
Akademiya Nauk SSSR, Moscow. Geologicheskii Inst.
For primary bibliographic entry see Field 4A.
W83-02257

CHANGES AND PROCESSES OF WATER RESOURCE DEVELOPMENT AND FLOOD CONTROL IN POST-SECOND WORLD WAR JAPAN,
Tokyo Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6D.
W83-02393

7. RESOURCES DATA

7A. Network Design

INTERVENTION ANALYSIS WITH MISSING DATA,
Washington Univ., Seattle. Dept. of Civil Engineering.
D. P. Lettenmaier.
Water Resources Research, Vol 16, No 1, p 159-171, February, 1980. 5 Fig, 6 Tab, 12 Ref.

Descriptors: *Data collections, *Time series analysis, *Intervention analysis, Mathematical equations, Mathematical models, Monte Carlo method.

Intervention analysis of environmental quality data is often limited by missing data. Whereas hydrologic and meteorological data sets are usually long and complete, environmental data sets are likely to be incomplete because of difficulty in collecting samples in extreme weather or the expense of some sophisticated analytical procedures. Two approaches for estimating missing data, one of which provides minimum variance estimates when model parameters are known, and a computationally simpler approximation were investigated. The approximation was found to quite adequate and was incorporated in a practical scheme to estimate missing data and model parameters simultaneously. Subsequently, a method for estimating the parameter variance for use in significance tests on the intervention magnitude was investigated. The adequacy of the approximation was assessed in a series of Monte Carlo tests using three models consisting of step, linear, and impulse decay trends in mean with residual lag 1 Markov noise. Results of the experiments indicated that the suggested method provides adequate estimates of the variance of the intervention magnitude of the step and impulse decay models but that the variance was substantially overestimated for the linear model. However, for the same proportion of missing data the accuracy of the approximation improved as the sample size increased. (Cassar-FRC)
W83-02275

A REGIONAL OCEAN MONITORING PLAN,
Southern California Coastal Water Research Project Authority, Long Beach.
W. Bascom.
In: Coastal Water Research Project, Biennial Report for the years 1981-1982, Willard Bascom, ed. p. 39-44.

Descriptors: *Municipal wastewater, *Monitoring, *Water quality standards, *Data collections, *Water analysis, Water quality, Research priorities, Specifications, Testing procedures, Outfall, Ocean dumping.

The EPA is about to permit the discharge of wastewater not subjected to secondary treatment under the 301h waiver plan into southern California's coastal waters. The author suggests the use of the Regional Ocean Monitoring Plan (ROMP) as a means to standardize sampling, preparation and analysis techniques. ROMP proposes specific ways in which monitoring can be more valuable and cost-effective. The proposed techniques include: sampling stations that are more evenly distributed; measurements at multiple control stations; bridging stations between outfall-affected areas; standardized equipment; standardized forms, charts, processing, archiving and data storage, analysis techniques and reporting procedures; computer storage of data by contributor; consistent personnel training; quality control procedures; and measurement of actual toxicity of all effluents after normal dilution. Research on future monitoring should proceed concurrently with the proposed monitoring. The objectives of the research would include developing better techniques for measuring and evaluating sub-lethal effects on marine environments; predicting changes in the biota; detecting the presence of new chemicals; analyzing data from a long-term viewpoint; continuing development of taxonomic identification procedures; counting small animals more accurately; and measuring subsurface currents. Few monitoring programs have adequately established clear objectives in advance. ROMP demonstrates that more useful data can be obtained at less cost if monitoring programs are modified in accordance with scientific findings. (Atkins-Omniplan)
W83-02302

VARIATION IN BENTHIC ASSEMBLAGES,
Southern California Coastal Water Research Project Authority, Long Beach.
B. E. Thompson.
In: Coastal Water Research Project, Biennial Report for the Years 1981-1982, Willard Bascom, ed. p. 45-58, 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Benthic environment, *Sampling, *Biological samples, *Outfall, *Biological properties, Species composition, Biomass, Sediment sorting, Pollution load, Contamination, Biological oxygen demand, Volatile solids, Chromium.

Changes in biological assemblages caused by effluent discharge can only be interpreted if the natural fluctuations in existing assemblages are known. The purposes of this study were to examine variation in the composition levels, and to determine the number of replicate grab samples necessary in future sampling to detect assemblages changes. It was assumed that a gradient of biological changes results from a gradient of outfall conditions. Measurements of three sediment paramters at 36 sites were made from grab samples collected concurrently with samples used for biological information. Total variable solids (TVS) wa used as a measure of organic material, biological oxygen demand (BOD) as a measure of microbial respiration, and chromium as a measure of general contamination. A general outfall gradient was quantified and divided into control, transition and contaminated zones. The most abundant species in each zone was usually distinct. Variation in numbers of species and individuals was highest in contaminated zone samples. Trends in species composition, numbers of species, individuals, and biomass along a generalized outfall gradient were similar at both the kilometer and meter sampling scales; however, the sample variation at the smaller scale was less variable. Changes in species composition of assemblages along outfall gradients can be seen with single samples and with replicated grab sam-

ples, but dichotmous sampling programs are suggested. (Atkins-Omniplan)
W83-02303

7B. Data Acquisition

PASSIVE MICROWAVE SENSING OF SOIL MOISTURE UNDER VEGETATION CANOPIES,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
T. J. Jackson, T. J. Schmugge, and J. R. Wang.
Water Resources Research, Vol 18, No 4, p 1137-1142, August, 1982. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Remote sensing, *Vegetation effects, *Soil moisture, Moisture availability, Vegetation, Environmental effects, Microwave sensing, Radiometers, Measuring instruments.

A procedure is developed for quantifying the effect of a vegetation canopy on the passive microwave emission from the soil. A theoretical model was used as the basis of a parametric model of the vegetative effect. The parametric model uses a single vegetation parameter, vegetation water content or wet biomass, which can also be estimated from remotely sensed data. Data collected over small plots, by using truck-mounted passive microwave radiometers were used to calibrate the parametric model and evaluate aspects of the theoretical model. Results show that a microwave radiometer operating at a 21-cm wavelength can provide volumetric surface soil moisture estimates to about 5% of accuracy for fields covered with moderate vegetation. In addition, all of the data required for applying the parametric model can be measured by remote sensing. (Baker-FRC)
W83-02146

A MODIFIED VACUUM-PRESSURE LYSIMETER FOR SOIL WATER SAMPLING,
Morrison and Associates, Inc., Newport Beach, CA.
R. D. Morrison.
Soil Science, Vol 134, No 3, p 206-210, September, 1982. 3 Fig, 22 Ref.

Descriptors: *Sampling, Soil properties, *Lysimeters, Leaching, Calcium, Chlorides, Iron, Magnesium, Manganese, Sodium, Lead, Zinc, Clogging, Design criteria, *Soil pore water sampling.

Soil pore water samples are collected by moisture extraction of a soil core or with in situ samplers. Lysimeters are the most common samplers, despite a number of inherent and sampler related problems. Sampler limitations were minimized through the design and construction of all-Teflon units for shallow and deep sampling. Design features in both units include detachable threaded components, the placement of the hydrophilic section midway on the vessel, and the ability to assemble a unit in the field best suited to the particular soil conditions. Leaching of Ca, Cl, Fe, Mg, Mn, Na, Pb, and Zn standards through the porous Teflon revealed no detectable attenuation. Clogging of the porous section occurred, although the proper installation and back-filling with silica flour minimized this effect. (Baker-FRC)
W83-02197

AN IMPROVED CORER FOR SOFT SEDIMENTS,
Southern California Coastal Water Research Project Authority, Long Beach.
W. Bascom, J. Mardesich, and H. Stubbs.
In: Coastal Water Research Project, Biennial Report for the years 1981-1982, Willard Bascom, ed. p 267-271, 2 Fig, 2 Ref.

Descriptors: *Cores, *Bottom sampling, *Sediments, Core drilling, Mud, Aquatic soils, Tubes.

For certain specific purposes it is essential to have precise and undisturbed cores of soft sediments as much as one meter long. The box corer is the best known device, but because of its weight can be unmanageable and dangerous on ships under 20 meters long. This project required a lighter more easily handled device. Three features make the tool that was designed particularly effective. First is its triggering mechanism: when an advance weight touches bottom a lever is released that allows the weighted core barrel to fall the final meter and the tin-edged barrel cuts into the mud with an equivalent weight of 900 kilograms, if taking a 30 meter long core. Second, to ensure that the tube holding the core remains tightly sealed, a rubber seal, coated with silicone at the top lid and at the disconnect joint, was designed which prevents air or water leaks. Third, was a design to hold the top lid completely open to prevent shock waves from disturbing the top surface of the sediments. Taking the core is instantaneous and automatic. To date, 40 cores have been taken in water dpeths of 30 to 500 meters with about 95% success. The longest core taken was 84 centimeters at a depth of 500 meters. This corer is lighter and less expensive than the box corer, but produces cores that are qualitatively the same. In 1981, a comparison was made between this corer and a box corer at one Los Angeles County Sanitation District. The muds were compared for copper contest. The results were equivalent and the LACSD adopted this device for future surveys. (Atkins-Omniplan)
W83-02310

MODELING OF THE MELTING OF SNOW IN MOUNTAINS AND ARRIVAL OF WATER ON THE DRAINAGE BASIN SURFACE WITH THE USE OF SATELLITE INFORMATION,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2C.
W83-02419

RADAR AND INFRARED REMOTE SENSING OF GEOTHERMAL FEATURES AT PILGRIM SPRINGS, ALASKA,
Alaska Univ., Fairbanks. Geophysical Inst.
K. G. Dean, R. B. Forbes, D. L. Turner, and F. D. Eaton.
Remote Sensing of Environment, Vol 12, No 5, p 391-405, 1982. 7 Fig, 25 Ref.

Descriptors: *Infrared imagery, *Remote sensing, *Geothermal studies, *Radar, Pilgrim Springs, *Alaska, Hot springs, *Thermal springs, Aircraft, Geologic fractures, Radiometry, Kigluaik Fault, Kuzitrin Fault.

Thermal anomalies and structural elements in the Pilgrim Springs area of Alaska were studied using radar and thermal data collected during high-altitude (60,000 ft) aircraft flights in July 1980. Like-polarized imagery was more effective in delineating significant linears than cross-polarized imagery. Many linears corresponded with known fractures and/or faults, which may be conduits for hot springs. Although the linears showed a wide range of orientation, significant concentrations were parallel to the trends of the Kigluaik and Kuzitrin faults. High-altitude thermal imagery, usable only on a smaller site-specific project rather than a regional study, detected anomalies associated with geothermal heat sources. Results were obtained by density-slicing analysis of evening imagery, since data collected in daytime were useless. A temperature difference of at least 2 C was required for recognition of a warm area. Most of the warm areas detected were lakes and streams. However, 3 major areas of warm ground in known hot spring regions were revealed by thermal imagery. (Cassar-FRC)
W83-02450

7C. Evaluation, Processing and Publication

FLOW-DURATION DATA FOR MISSOURI STREAMS,
Geological Survey, Rolla, MO. Water Resources Div.
L. D. Hauth.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $26.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-1189, 1982. 201 p, 2 Fig, 1 Tab.

Descriptors: *Flow duration, *Streamflow, *Data collections, Streams, Gaging stations, Sites, Hydrographs, Missouri.

Flow-duration data have been developed at 175 streamflow-gaging stations in Missouri that have at least 9 years of record. The flow duration is determined on a daily basis for period of record and presented as tables and hydrogrphs. The computation periods are 9, 19, 29, 39, or 49 years, depending on the length of continuous-streamflow records at each station. (USGS)
W83-02110

WATER RESOURCES DATA, HAWAII, WATER YEAR 1981. VOLUME I. HAWAII.
Geological Survey, Honolulu, HI. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-134791, Price codes: A13 in paper copy, A01 in microfiche. Geological Survey Water-Data Report HI-81-1, 1982. 266 p, 14 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Hawaii.

Volume 1 of water resources data for the 1981 water year for Hawaii and other Pacific Areas consists of records of stage, discharge, and water quality of streams; and water levels and water quality in wells and springs. This report contains discharge records for 106 gaging stations; water quality for 11 gaging stations, 103 partial-record flow stations, and 150 wells; and water levels for 21 observation wells. Also included are 106 crest-stage partial-record stations and 19 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, Federal, and other agencies in Hawaii. (USGS)
W83-02111

BASE FLOW OF STREAMS ON LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W83-02112

WATER RESOUCES DATA, ALABAMA, WATER YEAR 1981.
Geological Survey, Tuscaloosa, AL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-132035, Price codes: A24 in paper copy, A01 in microfiche. Geological Survey Water-Data Report A1-81-1, 1982. 540 p, 7 Fig, 1 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes Reservoirs, Wells, Water level, Data collections, Sites, *Alabama.

Water resources data for the 1981 water year for Alabama consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 104 gaging stations, stage only for 16 gaging stations, stage and contents for 12 lakes and reservoirs, water quality for 75 gaging stations and 54 wells, and water levels for 53 observation wells. Also included are 19 crest-stage partial-record stations, 9 flood hydrograph partial-record stations, and 88 water-quality partial-record stations. Additional water

data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Alabama. (USGS)
W83-02119

WATER RESOURCES DATA, CONNECTICUT, WATER YEAR 1981.
Geological Survey, Hartford, CT. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-144352, Price codes: A15 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CT-81-1, 1982. 325 p, 4 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Connecticut.

Water Resources Data for the 1981 water year for Connecticut consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 55 gaging stations; storm discharge at 7 gaging stations; tidal volume at 1 gaging station; contents at 35 lakes and reservoirs; water quality of 40 gaging stations, 4 lakes and reservoirs, 2 harbors, and 16 wells; and water levels at 58 observation wells. Also included are 43 crest-stage partial-record stations. Additional water data were collected at various sites involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. A few pertinent stations (not included above) in bordering States are also included in this report. These data represent that part of the National Water Data System operated by the U.S. Geological survey and cooperating State and Federal agencies in Connecticut. (USGS)
W83-02120

WATER RESOURCES DATA, GEORGIA, WATER YEAR 1981.
Geological Survey, Doraville, GA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-127837, Price codes: A20 in paper copy, A01 in microfiche. Geological Survey Water-Data Report GA-81-1, 1982. 446 p, 9 Fig, 1 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Georgia.

Water resources data for the 1981 water year for Georgia consists of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and ground-water levels. This report contains discharge records of 109 gaging stations; stage for 10 gaging stations; stage and contents for 17 lakes and reservoirs; water quality for 22 continuous stations, 131 periodic stations and miscellaneous sites; peak stage and discharge only for 106 crest-stage partial-record stations and 4 miscellaneous sites; measurements of discharge at 25 low-flow partial-record stations and 57 miscellaneous sites; and water levels of 28 observation wells. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Georgia. (USGS)
W83-02121

WATER RESOURCES DATA, MISSOURI, WATER YEAR 1981,
Geological Survey, Rolla, MO. Water Resources Div.
Geological Survey Water-Data Report MO-81-1, 1982. 394 p, 3 Fig, 3 Tab.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water level, Data collections, Sites, *Missouri.

Water resources data for the 1981 water year for Missouri consist of records of stage, discharge, and water quality of lakes and reservoirs. This report contains records for water discharge at 124 gaging stations; stage and contents at 7 lakes and reservoirs; and water quality at 33 gaging stations (including 1 lake). Also included are data for 30 crest-stage, 11 water-quality partial-record stations, and 20 low-flow partial-record stations. These data represent that part of the National Water Data System operated by the U. S. Geological Survey and cooperating State and Federal agencies in Missouri. (USGS)
W83-02122

WATER RESOURCES DATA, NORTH DAKOTA, WATER YEAR 1981. VOLUME 2. MISSOURI RIVER BASIN,
Geological Survey, Bismarck, ND. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-140236, Price codes: A22 in paper copy, A01 in microfiche. Geological Survey Water-Data Report ND-81-2, 1982. 492 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *North Dakota, Missouri River basin.

Water resources data for the 1981 water year for North Dakota consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. Volume 2 of this report contains 78 gaging stations; stage only records for 17 gaging stations; stage and contents for 7 lake and reservoirs; water quality for 55 gaging stations, 14 partial-record stations, 12 lakes, and 63 wells; and water levels for 14 observation wells. Additional water data were collected at various sites, not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U. S. Geological Survey and cooperating State ad Federal agencies in North Dakota. (USGS)
W83-02123

WATER RESOURCES DATA, INDIANA, WATER YEAR 1981.
Geological Survey, Indianapolis, IN. Water Resources Div.
Geological Survey Water-Data eport IN-81-1, 1982. 448 p, 6 Fig, 3 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Indiana.

Water resources data for the 1981 water year for Indiana consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 195 gaging stations, stage and contents for 12 lakes and reservoirs, releases from 6 flood-control reservoirs, water quality for 51 gaging stations, and water levels for 84 observation wells. Also included are 95 crest-stage partial-record stations and 42 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U. S. Geological Survey and cooperating State and Federal agencies in Indiana. (USGS)
W83-02124

WATER RESOURCES DATA, KANSAS, WATER YEAR 1981.
Geological Survey, Lawrence, KS. Water Resources Div.
Geological Survey Water-Data Report KS-81-1, 1982. 566 p, 10 Fig, 6 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Kansas.

Water resources data for the 1981 water year for Kansas consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells. This report contains discharge records for 153 gaging stations, stage and contents for 22 lakes and reservoirs, water quality for 75 gaging stations, and water levels for 481 observation wells and water quality for 319 wells. Also included are data for 91 crest-stage partial-record stations. All data in this report represent that part of the National Water Data System operated by the U. S. Geological Survey and cooperating State and Federal agencies in Kansas. (USGS)
W83-02125

VARIABILITY OF PRECIPITATION IN THE PACIFIC NORTHWEST: SPATIAL AND TEMPORAL CHARACTERISTICS,
Portland State Univ., OR. Dept. of Geography.
For primary bibliographic entry see Field 2B.
W83-02178

EVAPOTRANSPIRATION ESTIMATES BASED ON SURFACE TEMPERATURE AND NET RADIATION: DEVELOPMENT OF REMOTE SENSING METHODS,
Florida Univ., Gainesville. Dept. of Agronomy.
For primary bibliographic entry see Field 2D.
W83-02185

USERS MANUAL FOR COMPUTER MODEL TO PREDICT TOTAL ENERGY REQUIREMENTS OF IRRIGATION SYSTEMS,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W83-02225

ECOLOGICAL CHARACTERIZATION OF THE CENTRAL AND NORTHERN CALIFORNIA COASTAL REGION; VOLUME IV, WATERSHEDS AND BASINS.
Jones and Stokes Associates, Inc., Sacramento, CA.
For primary bibliographic entry see Field 2L.
W83-02311

WATER QUALITY MANAGEMENT STUDIES, LAKE SEMINOLE, FEBRUARY-DECEMBER 1979, PHASE II.
Water and Air Research, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5G.
W83-02312

PRECIPITATION CHARACTERISTICS AFFECTING HYDROLOGIC RESPONSE OF SOUTHWESTERN RANGELAND,
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
For primary bibliographic entry see Field 2B.
W83-02316

8. ENGINEERING WORKS

8A. Structures

SYSTEM OF FREEZING AND THERMOSTATING HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8C.
W83-02108

COUPLED DYNAMIC BEHAVIOUR OF REALISTIC ARCH DAMS INCLUDING HYDRODYNAMIC AND FOUNDATION INTERACTION,
Queen Mary Coll., London (England).
B. Nath, and S. G. Potamitis.
Proceeding of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 73, No 3, p 587-607, September, 1982. 15 Fig, 3 Tab, 28 Ref.

Descriptors: *Arch dams, *Reservoirs, *Hydrodynamics, Dam foundations, Dam design, Dam construction, Construction, Engineering, Mathematical equations.

A study is presented of the coupled dynamic behavior of realistic arch-dam reservoir systems, including both reservoir-dam and dam foundation interaction. The dam is assumed to be of circular cylindrical shape and located in a V-shaped valley, the acuteness of the V depending on the shape parameters of the dam. Novel mapping finite elements are used to represent the solid and the fluid aspects of the system. Results indicate that, depending on the overall stiffness of the dam, its coupled natural frequencies, mode shapes and response are influenced by hydrodynamic and foundation interaction. Also the effect of water compressibility is found to be small, so that it may be neglected in most arch-dam reservoir systems. The mapping finite element, used to represent the dam and its foundation, gives significantly better accuracy than when standard finite elements are used. (Baker-FRC)
W83-02201

AN APPROACH TO ASSIGNING THE MAXIMUM WATER DISCHARGE WHEN DESIGNING MAJOR HYDRAULIC STRUCTURES,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
T. F. Makarova, and L. F. Sotnikova.
Water Resources, Vol 9, No 1, p 27-31, January/February, 1982. 3 Fig, 1 Tab, 6 Ref. Translated from Vodnye Resursy, No 1, p 61-65, January-Feburary, 1982.

Descriptors: *Design floods, *Dam design, Streamflow, Floods, Flood peak, Hydraulic structures, Guarantee corrections, Statistical analysis.

Guarantee correction values are introduced into calculations for maximum discharges of hydraulic structures of the first class of importance, i.e., structures whose failure would result in catastrophic damages and many deaths. This results in design discharges considerably greater than those for a structure whose failure would not cause a catastrophe. Values of the guarantee corrections are usually associated with the probable errors in the estimate of the corresponding maxima. The introduction of differentiated values of the guarantee corrections permits a more valid approach to assigning the design maximum discharge. (Cassar-FRC)
W83-02254

THE IRVINE VALLEY SEWER SEA OUTFALL TUNNEL,
K. I. M. Henry, and G. I. McCall.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 4, p 389-298, 1982. 7 Fig, 2 Tab.

Descriptors: *Outfall sewers, *Sewers, *Tunnel construction, Diffusers, Hydraulic structures, Grouting, Excavation, Outfall, Construction, Tunnel linings, Linings, Tunneling, Scotland, Firth of Clyde, Irvine Bay.

Tunneling was the method chosen for constructing a sea sewage outfall in Irvine Bay, Firth of Clyde, Scotland. Completed in 1979, the outfall comprises two 1118 m OD cement-mortar lined steel pipes encased in concrete infill within precast concrete segments. The driven tunnel, 3.2 m inside diameter, is 2000 m long, 1500 m of which lies below the low water mark. One pipe has 9 diffuser upstands 300 mm diameter, each with four 140 mm ports. The other pipe has a terminal upstand 860 mm in diameter with two 250 mm ports and two 300 mm ports. The tunnel was driven with a machine at the average rate of 2.9 m per shift of 10-11 hours (24 hour, 5 day work week) through fractured sandstones, shales, mudstones, coal, and fireclay. For igneous rock, traditional drill and blast methods were used, achieving 1.7 m per shift. Average progress was 15.9 m per week, maximum, 49 m per week. Bad weather at sea frequently delayed work on the offshore works. (Cassar-FRC)
W83-02389

UNIFORM FLOW OVER SKEW SIDE-WEIR,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 4A.
W83-02400

8B. Hydraulics

ENVIRONMENTAL FEATURES FOR FLOOD CONTROL CHANNELS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 6G.
W83-02166

ADDITION TO TABLES OF ORDINATES OF THREE-PARAMETER GAMMA DISTRIBUTION,
Vologda State Water Management Planning Inst. (USSR).
M. M. Polyakov, and L. Kh. Vyazalov.
Water Resources, Vol 8, No 4, p 369-372, July/August, 1981. 2 Tab, 4 Ref. Translated from Vodynye Resursy, No 4, p 67-70, July/August, 1981.

Descriptors: *Variation coefficient, *Probability distribution, *Parameter hydrology, Hydrologic equation, Hydraulics, Skewness coefficient.

Tables of ordinates for three parameter gamma distributions, used in calculating probability curves in hydraulic engineering practice, are extended beyond the usual range of Cs = 1 to 4 times Cv, where Cs = coefficient of skewness and Cv = coefficient of variation. Parameters are given for Cs = 0, -Cv, and -Cv for Cv values of 0.1-0.5 and for Cs = 5Cv and 6Cv for Cv = 1.0-2.0. (Cassar-FRC)
W83-02239

HYDRAULIC INVESTIGATIONS BY NUMERICAL METHODS,
All-Union Planning, Surveying and Scientific-Research Inst., Moscow (USSR).
V. M. Lyatkher, and A. N. Militsev.
Water Resources (English Translation), Vol 8, No 3, p 247-262, May/June, 1981. 7 Fig, 36 Ref. Translated from Vodnye Resursy, No 3, p 60-79, May/June, 1982.

Descriptors: *Mathematical equations, *Hydraulics, Equations, Flow, Flow characteristics, Hydrodynamics, *Turbulence.

The idea of spatial averaging of flows and appropriate equations before performing the operation of probability averaging is presented. It appears during this study that the practical use of the equations obtained, regardless of the flow regime (laminar or turbulent), is posible with the introduction of a smaller number of assumptions and a smaller number of relatively simpler (directly measurable in experiment) empirical functions. The proposed approach does not completely solve the problem of turbulence, but it does permit taking definite steps in describing its low frequency, long-wave anisotropic component, which is most interesting in many engineering applications. (Baker-FRC)
W83-02242

A NOTE OF CHANGES IN CHANNEL GEOMETRY AT TRIBUTARY JUNCTIONS,
Hull Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 4A.
W83-02288

THE TRANSIENT RESPONSE OF COOLING PONDS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
E. E. Adams.
Water Resources Research, Vol 18, No 5, p 1469-1478, October, 1982. 7 Fig, 2 Tab, 13 Ref.

Descriptors: *Cooling ponds, *Powerplants, *Hydraulic transients, Ponds, Stratification, Flow rate, Temperature effects.

Cooling ponds are a form of closed cycle cooling used for steam-electric power plants. Because of their thermal inertia they provide an advantage over cooling towers in filtering fluctuations in intake temperature, which results in improved plant efficiency. By using linear systems theory, the transient behavior of various types of ponds is analyzed in response to periodic meteorological conditions (characterized by equilibrium temperature) and plant operational conditions (characterized by condenser temperature rise). Frequency response is expressed in terms of dimensionless ratios involving frequency of input forcing, characteristic hydraulic residence and surface response times, and appropriate mixing parameters. Results are also interpreted with respect to physical design variables, such as pond area, depth, degree of stratification, intake submergence, discharge entrance mixing, condenser flow rate, and temperature rise. While the nature of the sensitivity can be identified using the analysis, real optimization in terms of the physical design variables requires detailed physical model tests under controlled conditions and verification under less controlled, but more realistic, field conditions. (Baker-FRC)
W83-02350

8C. Hydraulic Machinery

SYSTEM OF FREEZING AND THERMOSTATING HYDRAULIC STRUCTURES,
P. M. Glamazdin, A. F. Zaichenko, and B. I. Lavrinenkoy.
Hydrotechnical Construction, Vol 15, No 12, p 772-774, December, 1981. 1 Fig, 2 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 12, p 38-39, December, 1981.

Descriptors: *Hydraulic engineering, *Construction, Dams, *Temperature control, Freezing, Thawing, Temperature, Thermostatic control, Frozen ground, Thermosiphons.

At present two types of dams are used for permanently frozen ground on the basis of construction and operating experience - warm and frozen. When operating, warm dams permit thawing of the frozen ground of the foundation and thawing of the body of the dam. Impermeability of such dams is provided by watertight elements. The impermeability of frozen dams is created by freezing the earth of the foundation and dam. Artificial freezing devices, including thermosiphons, columns and brine systems, are the means of freezing soils. A system for storing cold has been developed which makes it possible to freeze and maintain a negative temperature in the structure within the prescribed limits during the entire period of operation. The system consists of a cold-storage tank and two levels of vapor-liquid thermosiphons filled with ammonia or Freon. For practical realization of the freezing and thermostating system it is necessary to solve a number of engineering problems: selection of the material for the storage tank, methods of building up the length of the thermosiphons, and

repair of individual components of the system. (Baker-FRC)
W83-02108

TIDAL POWER GENERAL UTILIZING ATOMOSPHERIC PRESSURE OR AIR RECIRCULATION,
B. Jhun.
Water Resources Bulletin, Vol 18, No 5, p 885-888, October, 1982. 4 Fig.

Descriptors: *Tidal energy, *Hydroelectric plants, *Powerplants, Tidal powerplants, Atmospheric pressure, Air recirculation.

A tidal power generation method based on atmospheric pressure or air recirculation is also applicable to low head (< 10 m) hydroelectric power generation. The structures designed to use atmospheric pressure include two pools of differing heights separated by a dam and connected by an inverted U-tube which acts as a siphon. An air tube at the top of the discharge side allows small bubbles to enter, converting the potential energy of water into kinetic energy of air for operating air turbines. For producing power by air recirculation the same two pools, dam, and siphon tubes are used, with addition of pressure chambers with movable piston tops. The pressure chambers operate out of phase, creating a continuous air flow for driving air turbines. (Cassar-FRC)
W83-02169

A FOURTH UNIT FOR THE MAYFIELD HYDRO PROJECT,
A. C. Herstrom, L. A. Polivka, and R. B. Russell.
International Water Power and Dam Construction, Vol 34, No 7, p 36-40, July, 1982. 4 Fig, 3 Tab, 2 Ref.

Descriptors: *Model studies, *Hydraulic machinery, *Electrical equipment, *Hydroelectric power, Dams, Computer models, Hydraulic equipment, Electric power production, Financing, Construction costs, Fisheries.

A model study was conducted to maximize the use of available water on the Cowlitz River and to eliminate problems anticipated with the addition of a new unit to the Mayfield hydroelectric power plant. The model was calibrated for the existing geometry and flow conditions using field test data with a range of flow conditions. Computer models were used to study the upsurge in the forebay following a load rejection of all four units. The units are controlled from a duplex switchboard. A new line was installed from a new transformer with a new 230 kV circuit-breaker in the switchyard to connect the fourth generator. A contract was signed by the Washington Department of Fisheries and Game and City of Tacoma to maintain salmon and chinook populations at pre-dam levels. These environmental interventions caused some delay in licensing and engineering. Monthly meetings were held to closely manage the project. To finance the project and other improvements, the City of Tacoma borrowed $38 million. (Geiger-FRC)
W83-02223

THE ROCK ISLAND SECOND POWERHOUSE,
Stone and Webster Engineering Corp., Boston, MA.
For primary bibliographic entry see Field 8E.
W83-02373

8D. Soil Mechanics

THE MIXED GAMMA MODEL FOR CHANNEL LINK LENGTHS,
State Univ. of New York at Buffalo. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W83-02145

8E. Rock Mechanics and Geology

THE ROCK ISLAND SECOND POWERHOUSE,
Stone and Webster Engineering Corp., Boston, MA.
A. S. Lucks, C. A. Foster, T. J. Lyman, J. L. Rosenblad, and R. J. Conlan.
International Water Power and Dam Construction, Vol 34, No 7, p 25-29, July, 1982. 5 Fig.

Descriptors: *Dam construction, *Cofferdams, *Hydroelectric plants, Excavation, Rock excavation, Electric powerplants, Rock mechanics, Hydroelectric power, Spillways, Dams, Columbia River.

Before construction of the second powerhouse at the Rock Island hydroelectric facility on the Columbia River could be started, upstream and downstream cofferdams had to be built. Construction on the cofferdams was completed in June of 1975. The subsurface conditions of the second powerhouse foundation are described. The upstream embankment cofferdam was designed to be constructed underwater, while the downstream cellular cofferdam consisted of fourteen sheetpile cells and connecting arcs. Periodic maintenance of the cofferdams was required. To construct the second powerhouse, a right abatement fish ladder, right bank non-overflow section and retaining wall, and several spillways had to be demolished. Rock excavation and reinforcement and protection are discussed. The cofferdams performed well for over two and a half years. The sealing of the embankment by the underwater dumping of fine-grained non-plastic soils is very effective when a differential head can be established across the embankment during placement of the seal. (Geiger-FRC)
W83-02373

8F. Concrete

INVESTIGATIONS OF THE CHARACTERISTICS OF ELASTICITY AND CREEP OF CONCRETE IN THE ANDIZHAN RESERVOIR DAM,
I. E. Pukhov, and G. N. Kuleshov.
Hydrotechnical Construction, Vol 15, No 12, p 743-749, December, 1981. 3 Fig, 8 Tab, 1 Ref. Translated from Gidrotekhnicheskoe Stroite'stvo, No 12, p 21-25, December, 1981.

Descriptors: *Dams, *Design criteria, *Creep, *Concrete, *Elasticity, Temperature effects, Seasonal variations, Reservoirs, Andizhan Reservoir Dam, *USSR, Uzbekistan, Karadarya River.

The concrete buttress dam of the Andizhan reservoir, with a height up to 117 m and 3.8 million cubic meters of concrete, was constructed on the Karadarya River in Uzbekistan. A characteristic of the coarse aggregate for the concrete is the presence in it of slabby and acicular gravel in an amount up to 40%. Along with studying the characteristics of elasticity and creep of the concrete, studies were also made of its strength indices and unit weight. The rate of increase of the modulus of elasticity of concrete at an early age directly in the dam depended on the ambient temperature associated with exothermic heating of the cement in the concrete, season of concreting and other factors. The values of the modulus of elasticity of concrete placed at various times of the year equalize with increasing age of the concrete. The moduli of elasticity of concrete at a late age obtained on large laboratory specimens and directly in the structure are close in value. The creep of concrete of massive structures depends on the ambient temperature and, consequently, on the season of placing the concrete in the structure. Under the same temperature conditions, creep of concrete directly in the structure and of large laboratory specimens is close in value. (Baker-FRC)
W83-02107

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

DIRECTORY OF UNIVERSITY WATER EXPERTISE IN THE DISTRICT OF COLUMBIA - 1982,
District of Columbia Univ., Washington. Water Resources Research Center.
M. H. Watt, and L. C. Salvo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-180315, Price codes: A03 in paper copy, A01 in microfiche. D.C. Water Resources Research Center Report No 40, September, 1982. 39 p. OWRT A-999-DC(4), 14-34-0001-0109.

Descriptors: *Universities, *Scientific personnel, *Laboratories, *Training, *Evaluation, *Water expertise education information dissemination, University research, *District of Columbia, Research facilities, Grants, Technology transfer.

The directory of university water expertise serves to help dissmeninate information on the water and water resources of the District of Columbia. The directory was assembled for several purposes including: (1) to identify as nearly as possible all the faculty members of unversities in the District of Columbia who are actively involved in one or more aspects of water and/or water resources (86 faculty members were identified), 2) to facilitate communication among faculty members with water expertise and interests, so that duplication of effort can be minimized. The information on which this directory is based was obtained from the faculty member him/herself. Questionnaires were sent to all university faculty in the District of Columbia known to be involved in water and/or water related research activities. The directory is composed of three sections: (1) an alphabetical list of faculty members, (2) a cross-index in which faculty are categorized by their area/s of water expertise, (3) a second cross-index in which faculty are listed according to their university affiliation.
W83-02294

9C. Research Facilities

DIRECTORY OF WATER-RELATED ORGANIZATIONS IN THE DISTRICT OF COLUMBIA,
District of Columbia Univ., Washington. Water Resources Research Center.
M. H. Watt, and L. C. Salvo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-180323, Price codes: A05 in paper copy, A01 in microfiche. District of Columbia Water Resources Research Center Report No 41, November 1982. 63 p. OWRT A-999-DC(5), 14-34-0001-0109.

Descriptors: *Federal government, *States government, *Jurisdiction, Employment opportunities, Social paricipation, Federal-state water rights conflicts, *Institutes, Research and development, *Laboratories, Sewage districts, Zoning, *District of Columbia.

The directory of water related organizations in the District of Columbia provides a listing of organizations working with or related to the field of water resources. The organizations listed include: the federal goverment, the District of Columbia, regional agencies, research and academic institutions, private firms, citizen committees and private interest organizations. For each organization the directory gives the name, the key people, the mission and objectives, the structure and the involvement and the interest in water and water related activities. Organizations in the body of the directory are listed by categories. The format of the Table of Contents should help to understand some of the hierarchical interrelationships among organizations. The Glossary of Acronyms is intended to aid the identification of organizations and some of the special vocabulary used among water-related orga-

nizations. An alphabetical index will help in location of organizations within the directory.
W83-02295

DIRECTORY OF GROUNDWATER PROGRAMS AND ACTIVITIES OF THE FEDERAL GOVERNMENT.
Department of the Interior, Washington, DC. Office of Water Policy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182048, Price codes: A05 in paper copy, A01 in microfiche. Report issued by Office of Water Policy, U.S. Department of the Interior, February 1983. 79 p.

Descriptors: Groundwater, Aquifer, *Groundwater resources, *Aquifer management, Directories, *Groundwater directories, *Federal government, *Federal jurisdiction, Water policy, Federal project policy, Legal aspects, Information exchange.

This directory provides brief descriptions and contacts for additional information on each of 44 groundwater programs and recurring groundwater-related activities of the Federal Government. It was prepared in response to requests from the Interstate Conference on Water Problems and the National Governors' Association and with the assistance of the agencies identified herein. The directory contains a listing of those regulatory, technical assistance, research, funding and land management activities of the Federal Government that have as their primary purpose the monitoring, protection or conservation of groundwater quantity and quality. Agencies were asked to submit for the directory only those activities that have groundwater as a primary component, where the Federal government is the principal decisionmaking authority and which are longer than one year duration. Some Federal activities that impact on groundwater are left out intentionally. Enough detail is provided in the descriptive summary to allow a user to decide whether the activity is related to a particular problem. More information can then be obtained from the agency contact. An attempt has been made to identify persons who would be most familiar with local groundwater situations. List of regional and State contacts are provided for many activities. The legislative authority for each activity is cited in such a way that user can locate the information in university libraries and many of the larger municipal libraries.
W83-02361

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

BIBLIOGRAPHY ON GROUND-WATER RECHARGE IN ARID AND SEMIARID AREAS,
Arizona Water Resources Research Center, Tucson.
S. J. Keith, P. Paylore, K. J. DeCook, and L. G. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182055, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Tucson, AZ, July, 1982. 149 p. OWRT C-00155-T(1483)(1), 14-34-0001-1483.

Descriptors: Groundwater, *Groundwater recharge, *Arid climates, Groundwater quality, Isotopes, Stable isotopes, Radioisotopes, Tracers, Groundwater management, Landfills, Irrigation, Land use, Water quality, Mining, Models, Water pollution effects, Waste water, Safe yield, Nitrates, *Bibliographies, Ephemeral flow recharge, Mountain recharge, Sahara Desert, Basin and range province, Kalahau Desert.

This bibliography provides references on natural and man-caused recharge in arid and semiarid areas. The literature on natural recharge includes citations on stream channel recharge, mountain recharge, mountain-front recharge, and precipitation-infiltration recharge. The literature on man-caused recharge includes citations on recharge from activities such as irrigation, mining, and waste-water treatment and disposal, but does not include citations on artificial recharge. Most citations are abstracted; all are keyworded. The bibliography may be accessed through keyword and author indices.
W83-02362

10F. Preparation Of Reviews

RURAL DRINKING WATER TECHNOLOGY TRANSFER ASSESSMENT,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 5F.
W83-02318

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